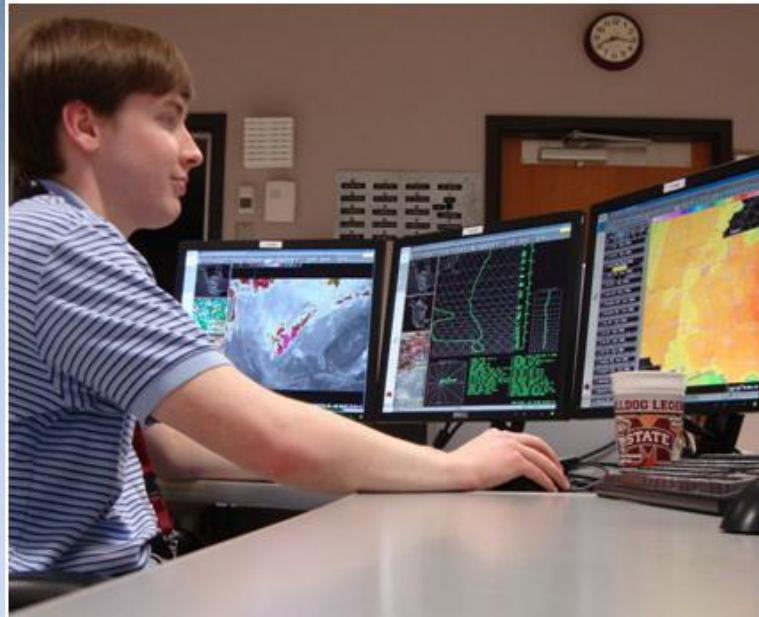




# Spring 2015 Graduate Spotter Class



Gary Goggin  
Meteorologist

U.S. Department of Commerce  
National Oceanic and Atmospheric Administration  
National Weather Service – Birmingham, AL

# Welcome to the Graduate Spotter Class

## What we will attempt to cover in this class:

- Quick review of a few slides from the Basic Course
- Advanced weather concepts including a 3-D look at the atmosphere.
- Instability versus Wind Shear – Finding the perfect balance.  
How do you arrive at the mode of convection in the forecast?
  - “The ‘why’ of what you observe when storm spotting”
- Radar Signatures
- Dual Polarization Concepts



# GRADUATE STORM SPOTTER CLASS

## WATCH VS. WARNING

### HAZARDOUS WEATHER OUTLOOK

- Anticipated hazardous weather over next 7 days
- Issued 3-4 times per day

### TORNADO / SEVERE THUNDERSTORM WATCH

- Conditions are **favorable** for severe thunderstorms / tornadoes
- Issued by SPC, last 3 to 6 hours

### TORNADO / SEVERE THUNDERSTORM WARNING

- Conditions are **occurring** or about to occur
- Issued by local NWS office, last 30-60 minutes



WATCH THE SKY!



TAKE ACTION!!!

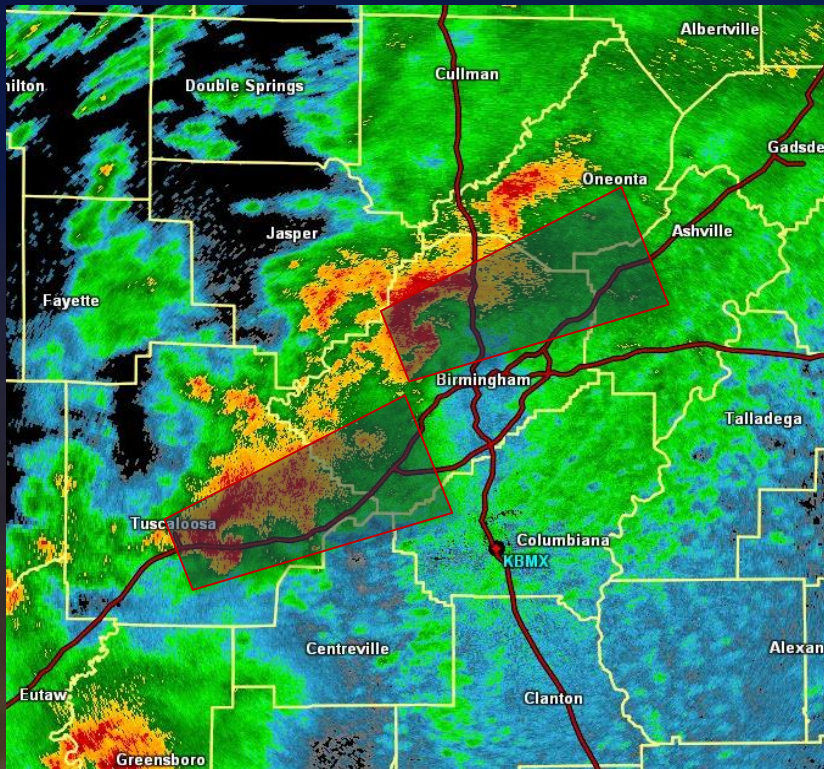




# GRADUATE STORM SPOTTER CLASS

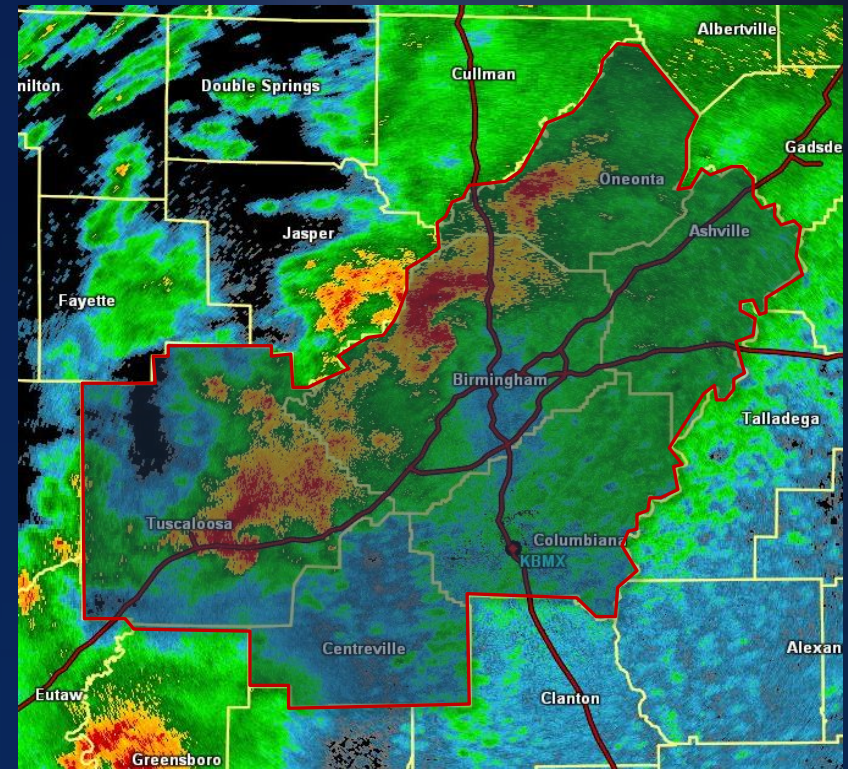
## *Polygon Warnings vs. Weather Radio/Sirens*

### *Polygon Warnings*



Storm-based, only cover portions of counties

### *NWR & (Most) Sirens*



NOAA Weather Radio & most\* outdoor sirens sound for entire counties.

\*Note: Some counties have the ability to sound sirens for more specific locations.

#ReadyAL

NWSBirmingham







# GRADUATE STORM SPOTTER CLASS

## RECEIVING WEATHER ALERTS

*It's imperative that you have MORE THAN ONE way to receive weather alerts!!*

### At Home

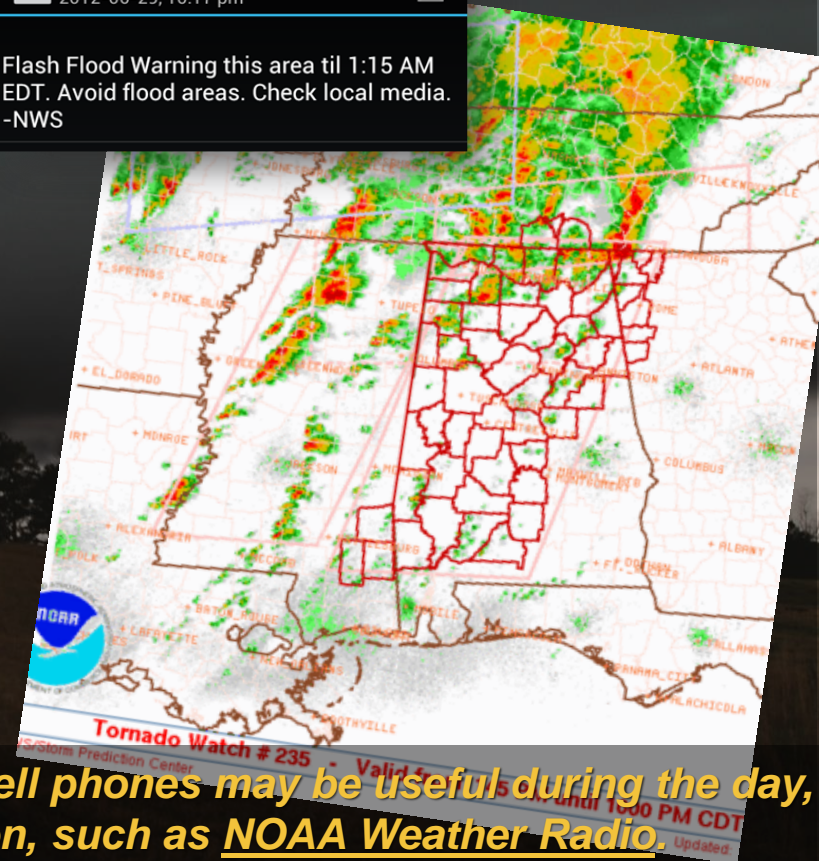
- NOAA Weather Radio
- Television
- Battery-operated Radio
- Internet

### On the Go

- Car Radio
- Handheld NOAA Weather Radio
- Cell Phone (text messaging services/apps)
- Social Media (Facebook/Twitter)

Severe alert  
2012-06-29, 10:17 pm

Flash Flood Warning this area til 1:15 AM EDT. Avoid flood areas. Check local media.  
-NWS



*Keep in mind that although sources such as TV and cell phones may be useful during the day, you also need a nighttime source of information, such as NOAA Weather Radio.*



# GRADUATE STORM SPOTTER CLASS

*NWS Social Media*

**US National Weather Service**  
**Birmingham Alabama** ✓  
Government Organization

Like Follow Message

Timeline About Likes Photos More

PEOPLE

★★★★★  
70,696 likes  
73 visits

Invite your friends to like this Page

ABOUT

Facebook posts do not always reflect the most current information. For current official info, visit <http://www.srh.noaa.gov/bmx>

<http://www.srh.noaa.gov/bmx>

✓ Suggest Edits

PHOTOS

Post Photo / Video

Write something...

Post

**US National Weather Service Birmingham Alabama**  
3 hrs ·

There will be some clouds and patchy fog across central Alabama early this morning, but mostly sunny conditions will prevail for most of the day. Highs will be in the 70s.

Issued 15-Mar-15  
**Birmingham**  
At 3:51 AM

**TODAY**  
*High Temperatures*

Early morning clouds and fog, otherwise mostly sunny.

Clouds Decreasing

Map showing temperatures across Alabama:

Location	Temperature
Hamilton	73
Gadsden	72
Birmingham	73
Anniston	73
Tuscaloosa	76
Alexander City	76
Clanton	76
Auburn	76
Demopolis	77
Selma	78
Montgomery	78
Enterprise	78

[facebook.com/NWSBirmingham](https://facebook.com/NWSBirmingham)

- Like our page!
- Submit reports via our wall or message
- Constantly updated during times of severe weather





# GRADUATE STORM SPOTTER CLASS

*NWS Social Media*

Home Notifications Messages Discover



Search Twitter



**NWS Birmingham**

@NWSBirmingham

Official Twitter account for the National Weather Service Birmingham Alabama.  
Details: [weather.gov/twitter](https://weather.gov/twitter)

Birmingham, Alabama

[srh.noaa.gov/bmx](https://srh.noaa.gov/bmx)

Joined May 2012

4,696 Photos and videos



TWEETS 9,579 FOLLOWING 149 FOLLOWERS 14.3K FAVORITES 15 LISTS 8

Tweets Tweets & replies Photos & videos

**NWS Birmingham** @NWSBirmingham · 3h  
Some fog out there this morning, but look for clearing skies by this afternoon with highs in the 70s. No rain! [#alwx](#)

9 1

**NWS Birmingham** @NWSBirmingham · 7h  
Patchy Dense Fog over portions of central Alabama, mainly north of I-85. Sudden reductions in visibilities may occur when driving. [#alwx](#)

6

**NWS Birmingham** @NWSBirmingham · Mar 14  
A few rain showers possible in the N & E today, but overall drier conditions. Highs in the upper 60s N to upper 70s S. [#alwx](#)

[twitter.com/NWSBirmingham](https://twitter.com/NWSBirmingham)

- Follow us!
- Submit reports to @NWSBirmingham
- [\*\*#alwx\*\*](#) or [\*\*#bmwx\*\*](#)
- Constantly updated during times of severe weather

<https://twitter.com/NWSBirmingham>

BHM.jpg



## Birmingham, AL

[Home](#)[Site Map](#)[News](#)[Organization](#)Search for: ☐ NWS☐ All NOAA 

## Top News of the Day

- Next SKYWARN Spotter Class is in Wetumpka on March 17th at 6pm.
- Weather History: Tornadoes of March 18, 1996
- Missed a Headline? Click Here for Past Headlines

Today

Tonight



Issued 15-Mar-15

Birmingham

At 3:51 AM

TODAY

High Temperatures



Early morning clouds and fog, otherwise mostly sunny.



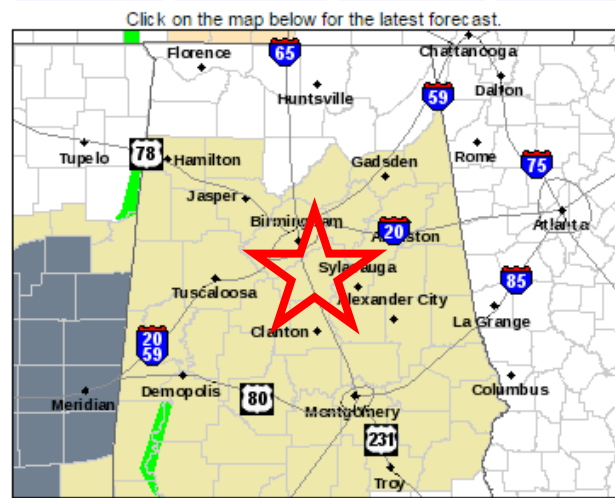
NWSBirmingham

[Show Descriptions](#)[Watches & Warnings](#)[Observations](#)[Forecast Graphics](#)[Rivers & Lakes](#)[Climate](#)[Multimedia Briefing](#)[weather.gov/bmx](http://weather.gov/bmx)

\*Graphiccasts

\*Hazardous Weather Outlook

\*Multimedia Briefings



[Read watches, warnings & advisories](#)

Zoom Out

[Flood Warning](#)

[Dense Fog Advisory](#)

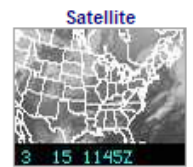
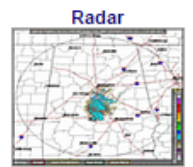
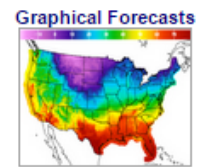
[Special Weather Statement](#)

[Hazardous Weather Outlook](#)

Latest Conditions in Birmingham, AL Choose Your Front Page City

Mar 15  
**6:53 am**  
  
**58°F**  
(14°C)

Select A City:



LOCATION	TIME[edt]	WEATHER	TEMP	DEWPT	RH %	WIND mph	PRESSURE	SUNRISE/SUNSET
<a href="#">Alex City</a>	07:15 AM	Fog/Mist	57°F	53°F	88%	Calm	30.23 in	6:56 AM/6:51 PM
<a href="#">Anniston</a>	06:53 AM	Partly Cloudy	59°F	56°F	90%	N 8	30.21 in	6:56 AM/6:50 PM
<a href="#">Auburn</a>	07:35 AM	Fair	55°F	52°F	88%	N 7	30.23 in	6:54 AM/6:49 PM
<a href="#">Birmingham</a>	06:53 AM	Overcast	58°F	57°F	97%	N 3	30.24 in	6:59 AM/6:54 PM
<a href="#">Calera</a>	06:53 AM	Fog/Mist	57°F	56°F	96%	Calm	30.22 in	6:59 AM/6:54 PM
<a href="#">Montgomery</a>	06:53 AM	Fair	58°F	55°F	90%	Calm	30.21 in	6:57 AM/6:53 PM
<a href="#">Troy</a>	06:53 AM	Fog/Mist	55°F	54°F	96%	Calm	30.21 in	6:56 AM/6:51 PM
<a href="#">Tuscaloosa</a>	06:53 AM	Fair	57°F	56°F	96%	Calm	30.22 in	7:02 AM/6:57 PM

CLICK ON LOCATION FOR PREVIOUS THREE DAYS OF OBSERVATIONS

Latest Text Product Selector (Selected product opens in a new window)

Choose a Text Product

# Point Specific Information

- \*Watches
- \*Warnings

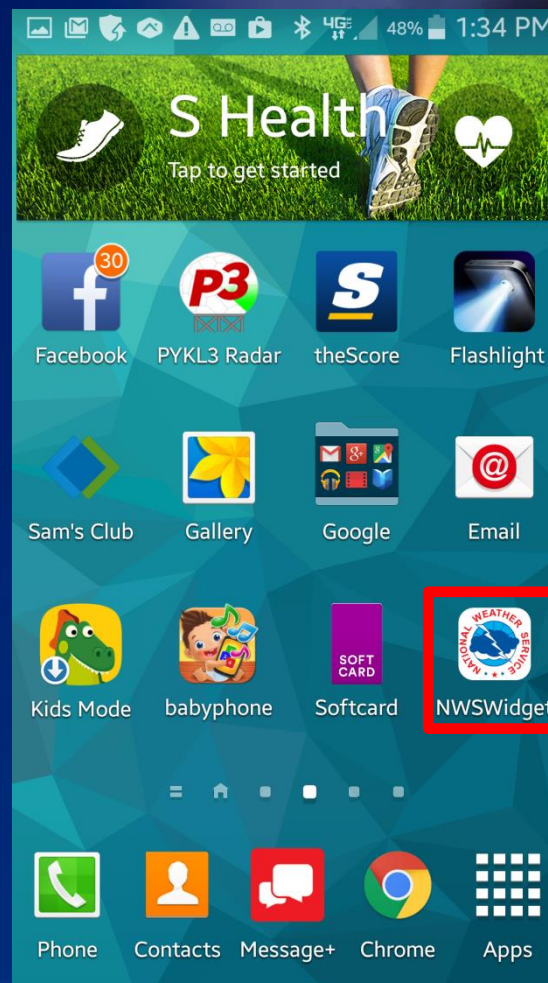
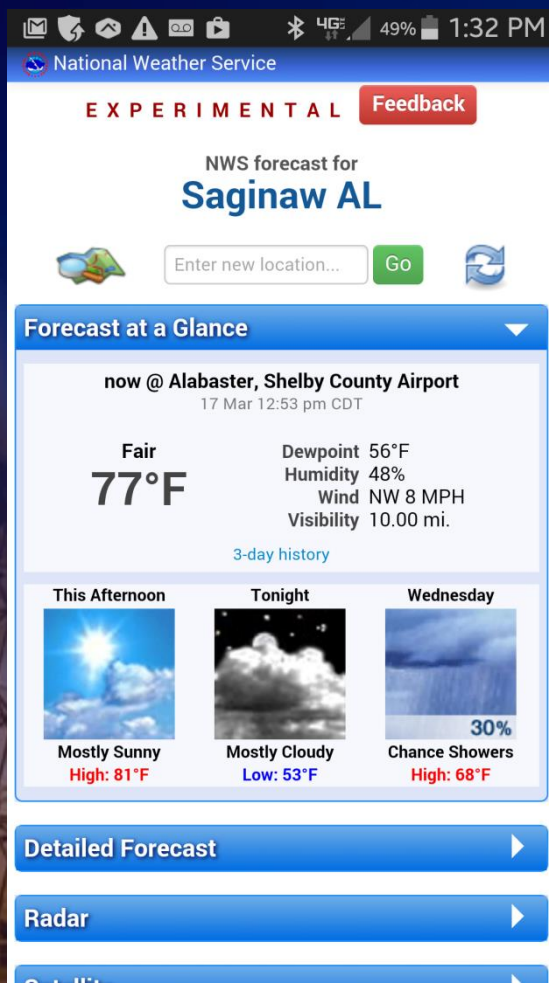




# NWS Widget for Smartphones



Google “NWS Widget” and select first link at the top. Enter your Zip Code.

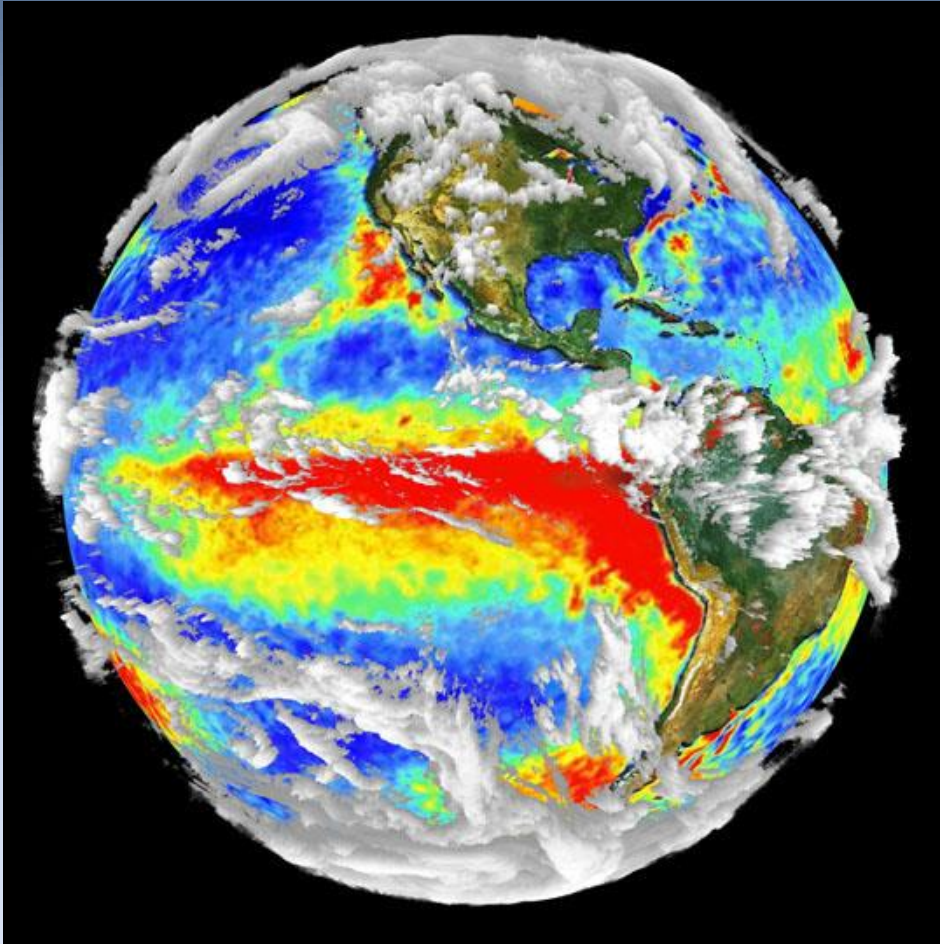








# The Atmosphere



Large to Small Scale

- Global (Largest)
- Synoptic (Large)
- Mesoscale (Small)

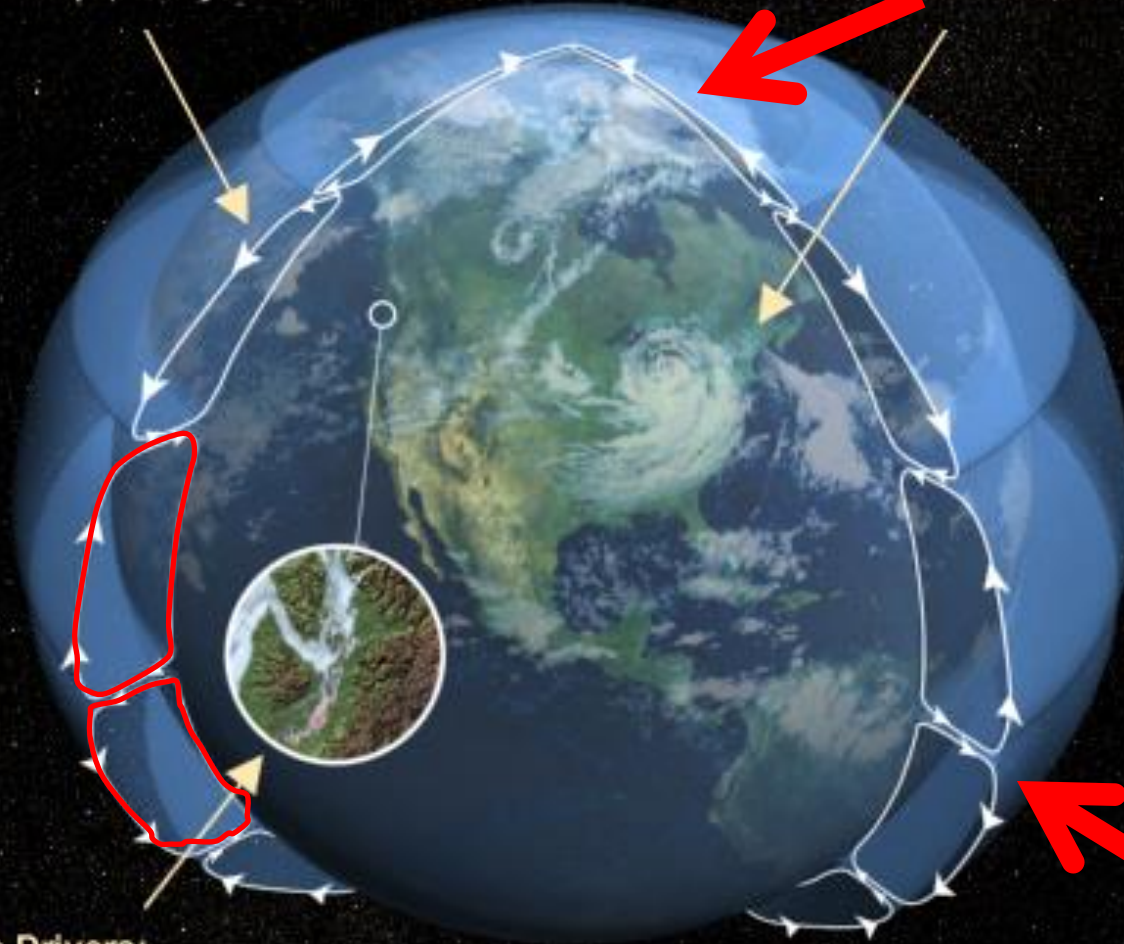
# Global Weather Patterns

## Global-Scale Drivers

- General atmospheric circulation, etc.
- From 1000s of km to planetary motions

## Synoptic-Scale Drivers

- Jetstreams and fronts, etc.
- From a few hundred km to 1000s of km



## Mesoscale Drivers:

- Air-sea interactions, etc.
- From 1 km to a few hundred km



# Global Weather Patterns

Weather Patterns

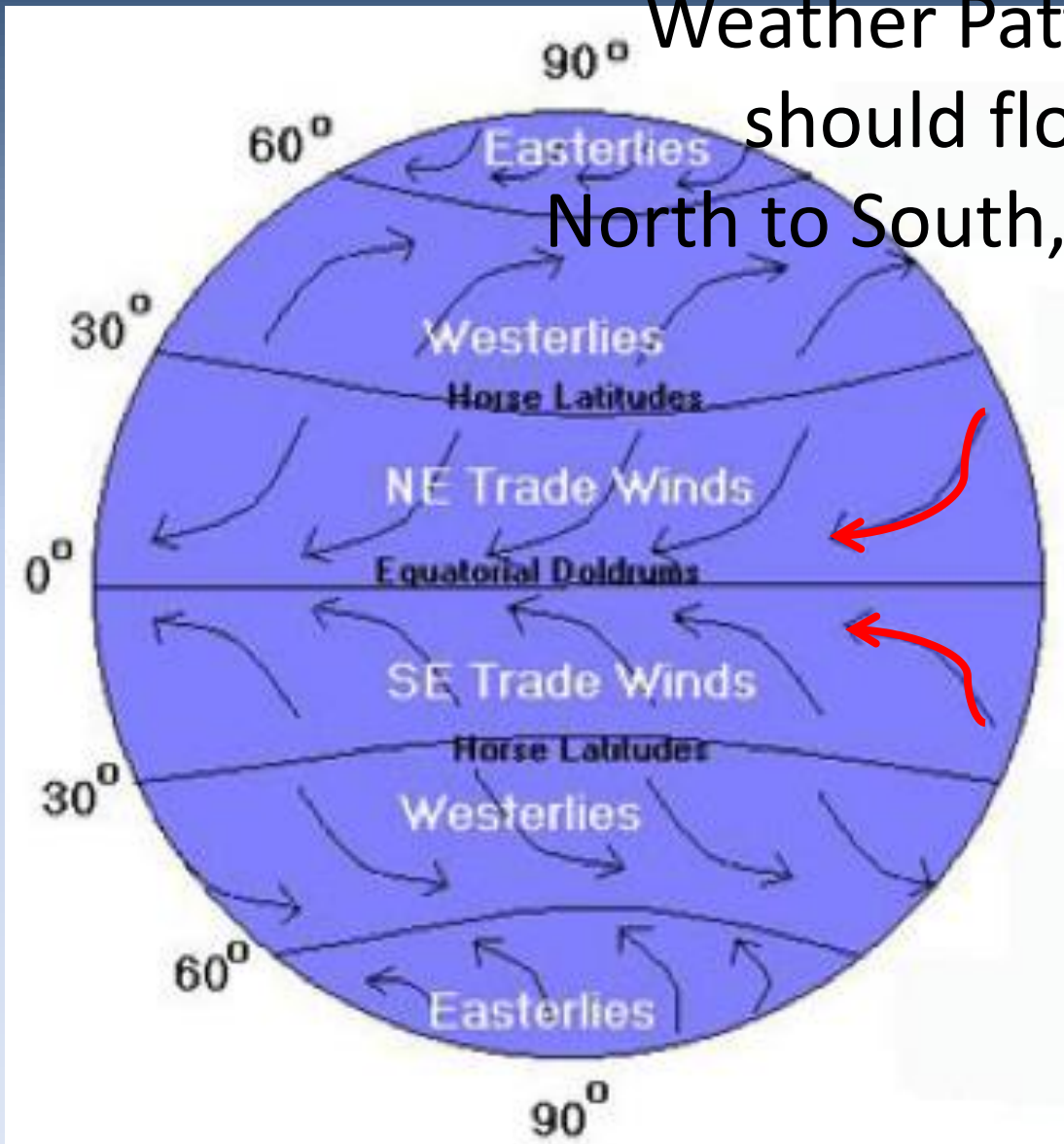
should flow

North to South, RIGHT

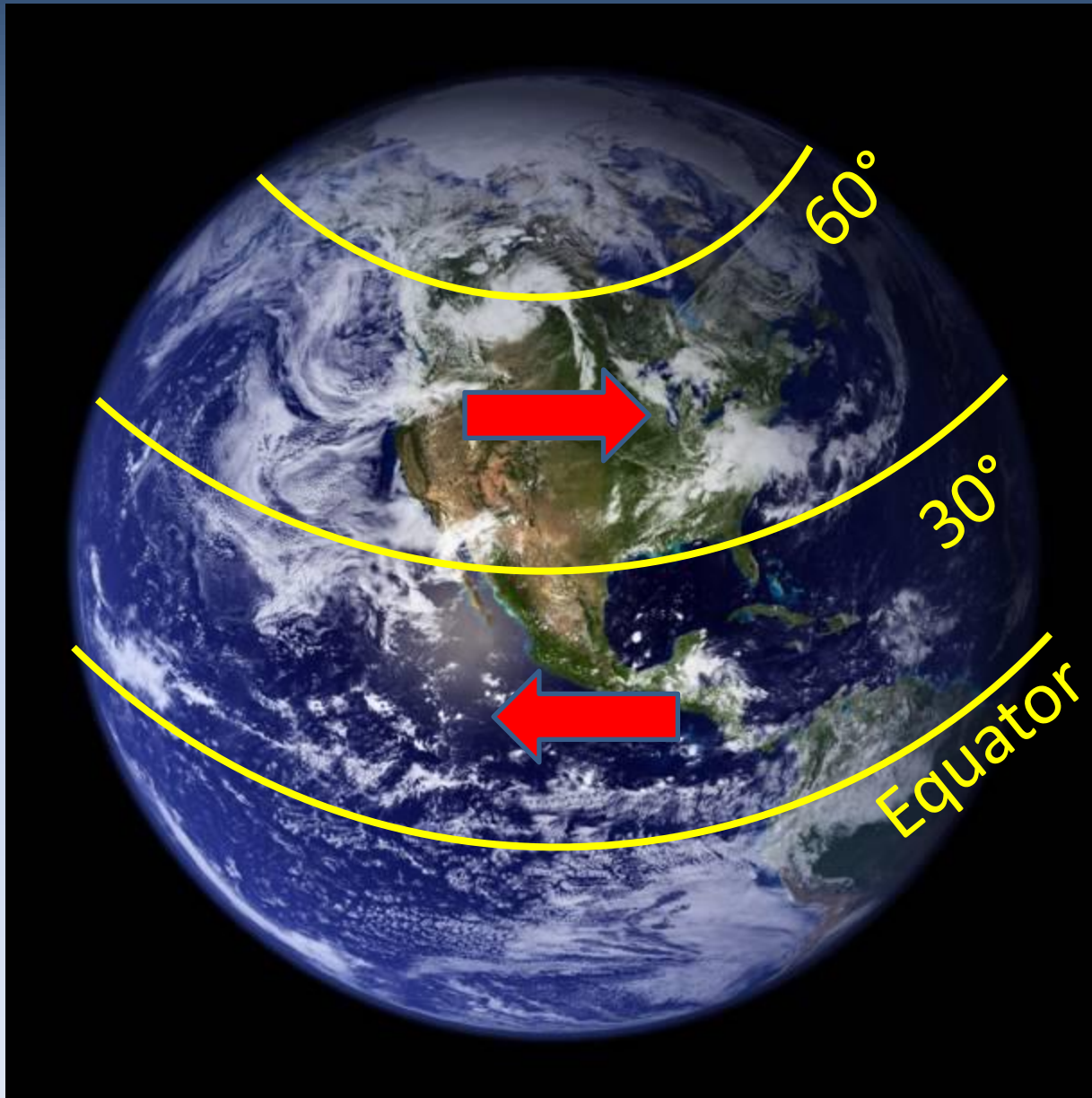
Factor in:

- Rotation of the Earth
- Gravity

**Coriolis Effect**



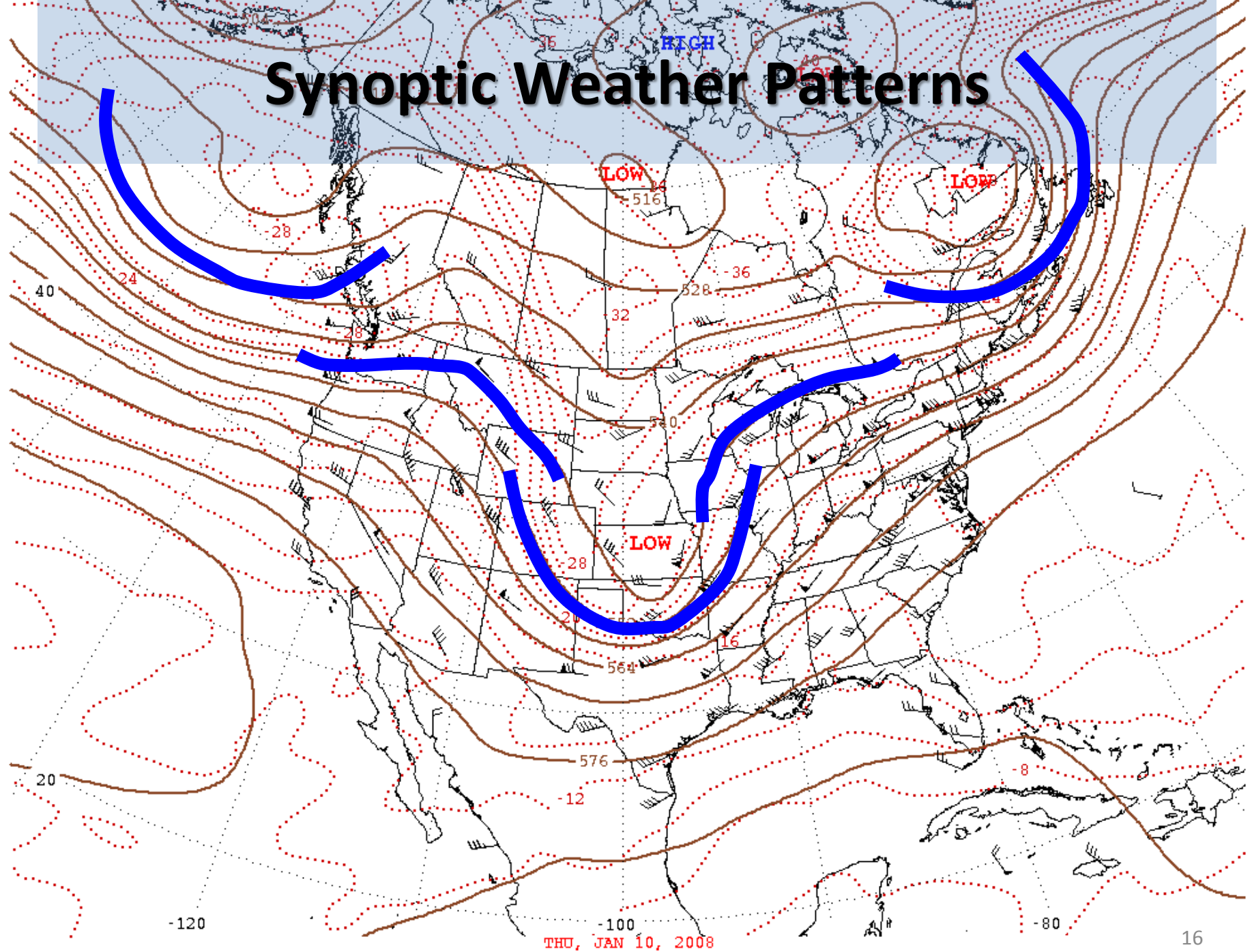
# Global Weather Patterns



## Westerlies vs. Easterlies

- Most of our weather comes from the west
- Hurricanes come from the east

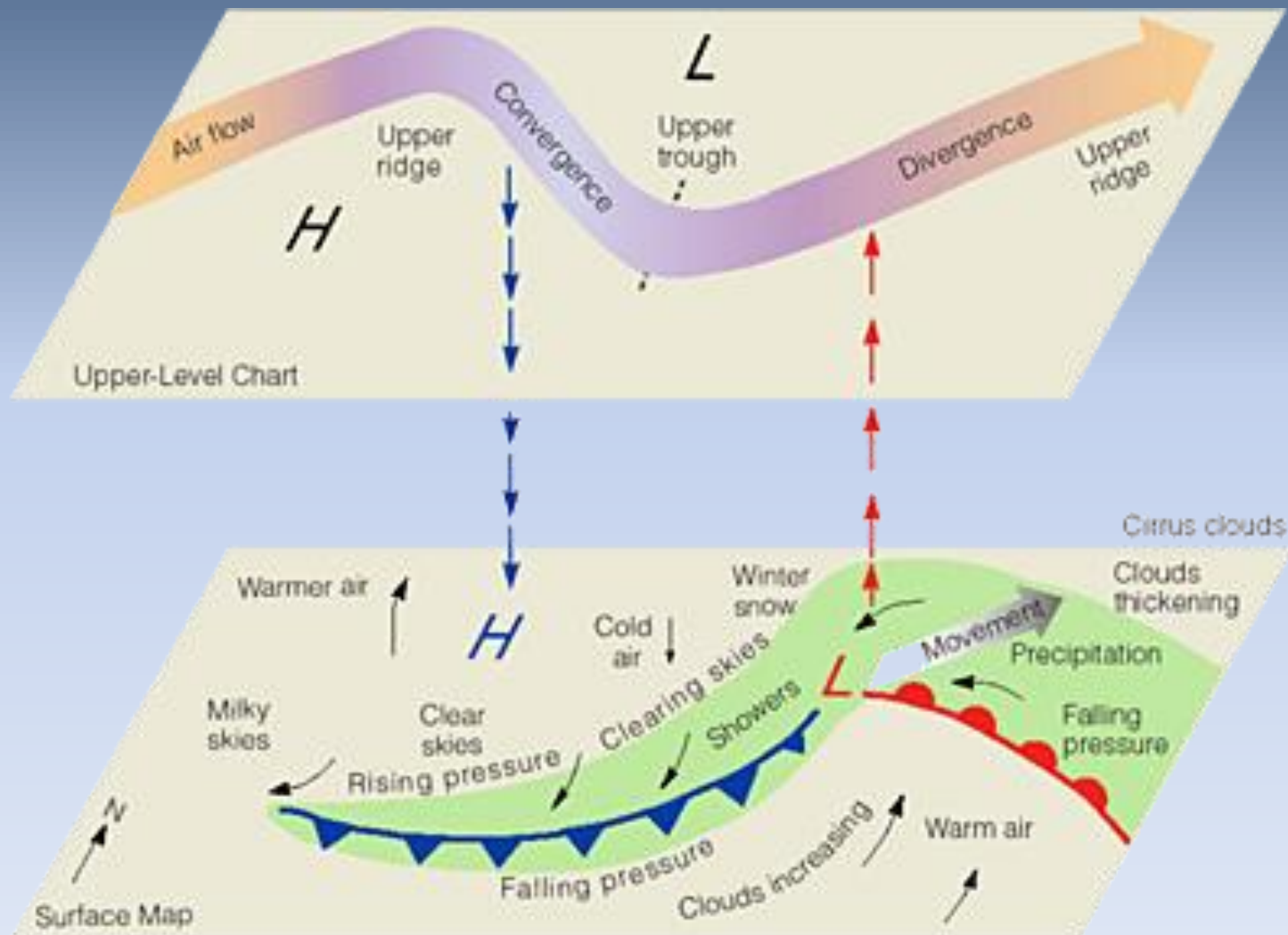
# Synoptic Weather Patterns



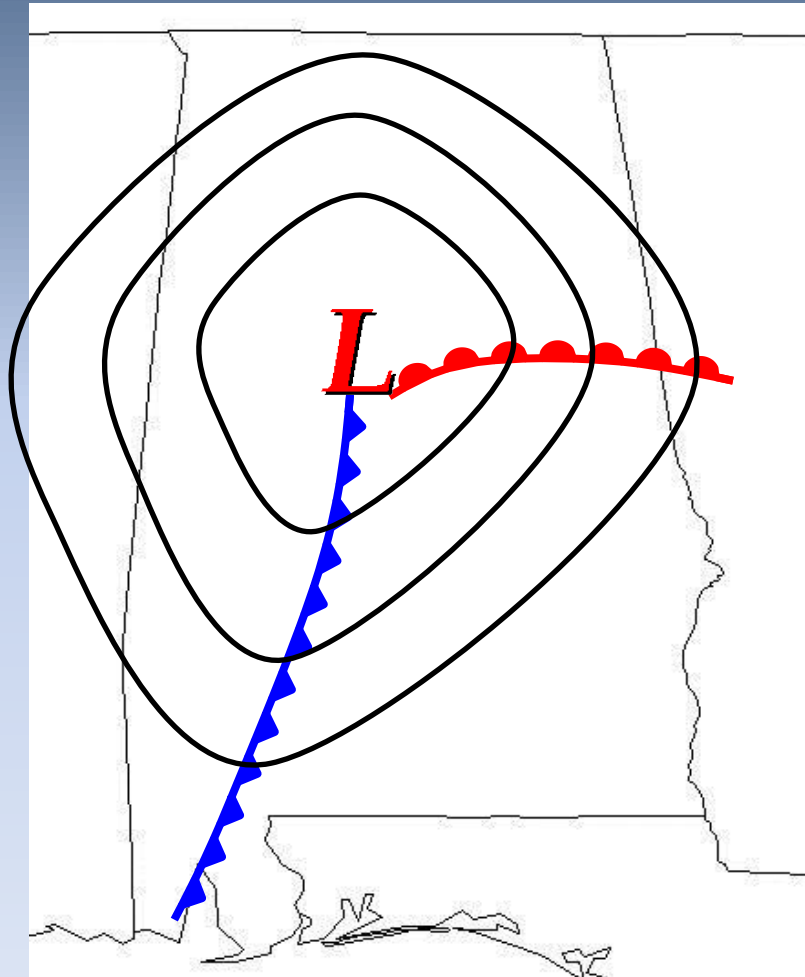
500-Millibar Height Contours at 7:00 A.M. E.S.T.



# Synoptic Weather Patterns: Thinking in 3-D

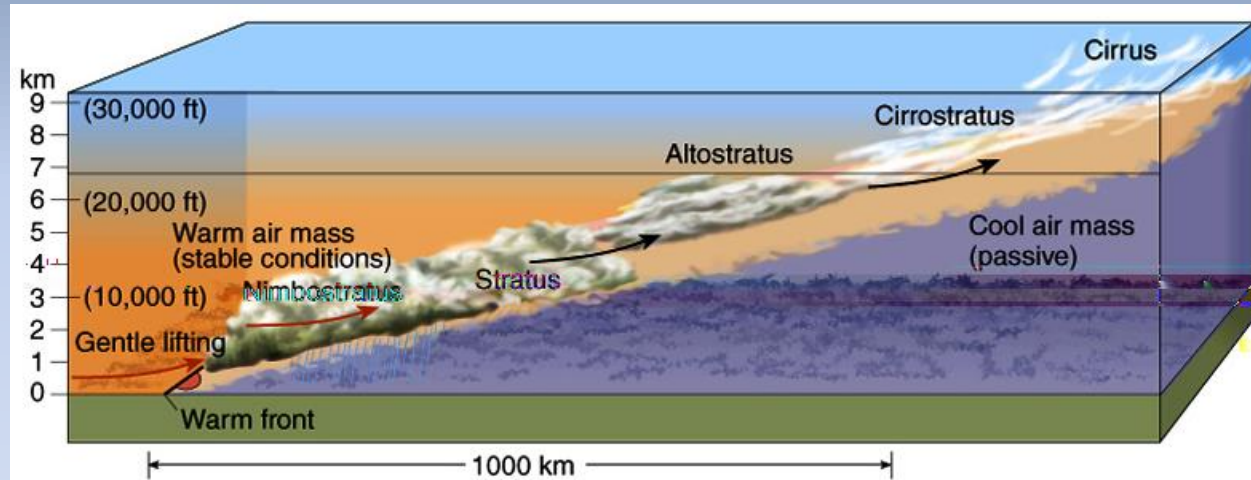
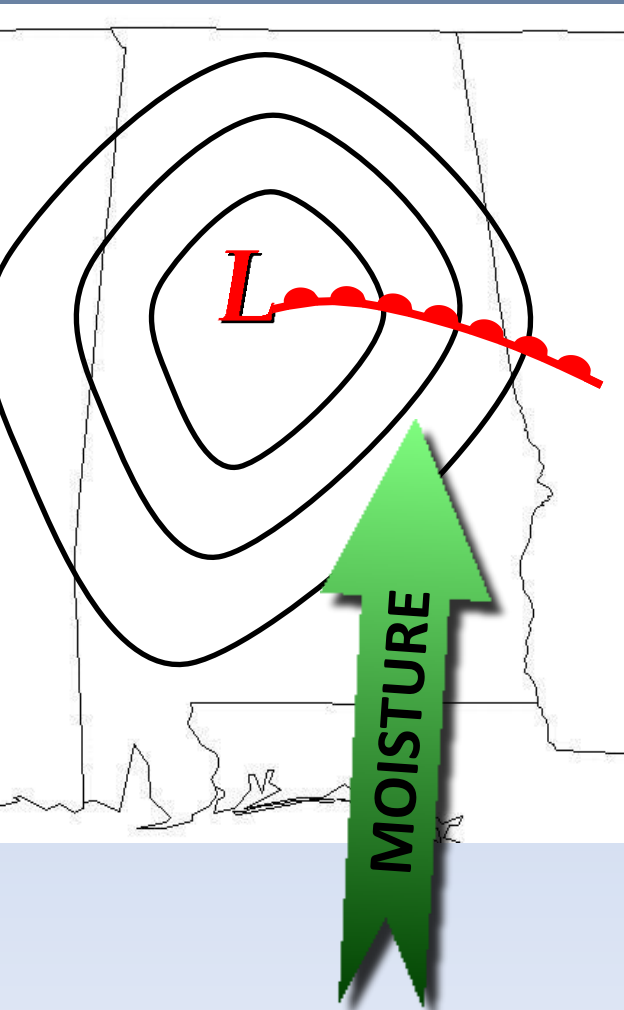


# Synoptic Weather Patterns: Low Pressure System



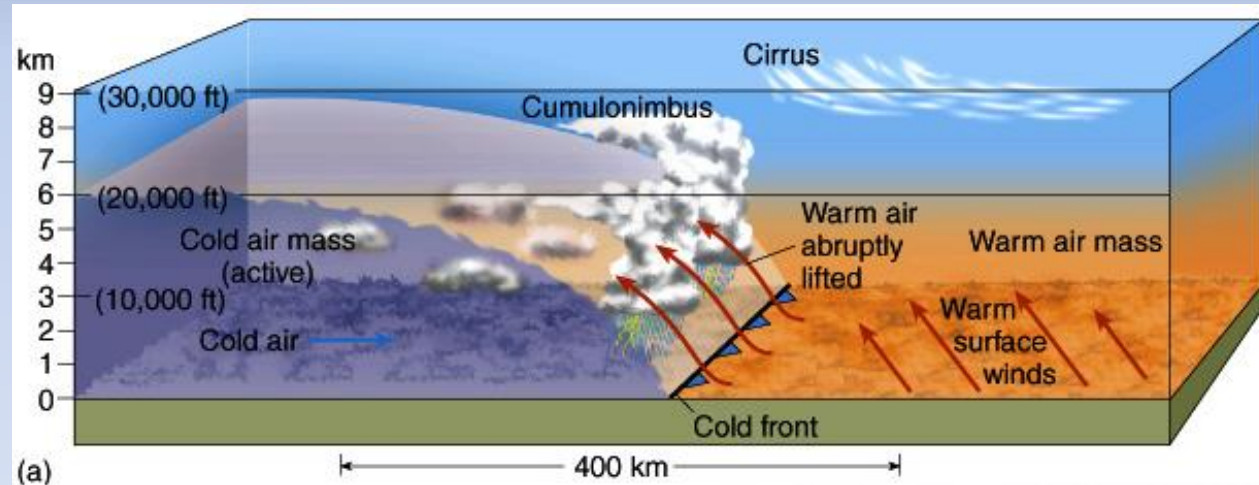
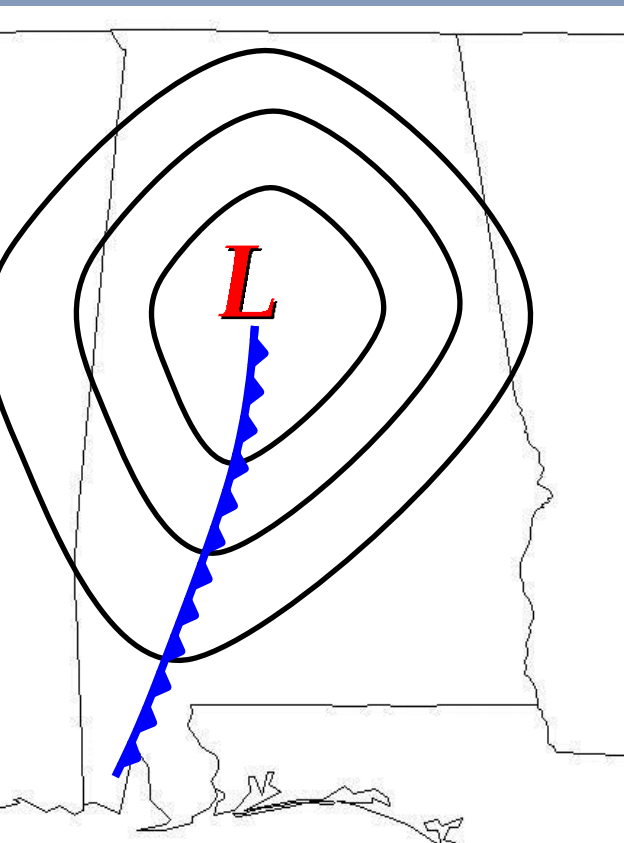


# Synoptic Weather Patterns: The Low Pressure System



Warm Front

# Synoptic Weather Patterns: The Low Pressure System

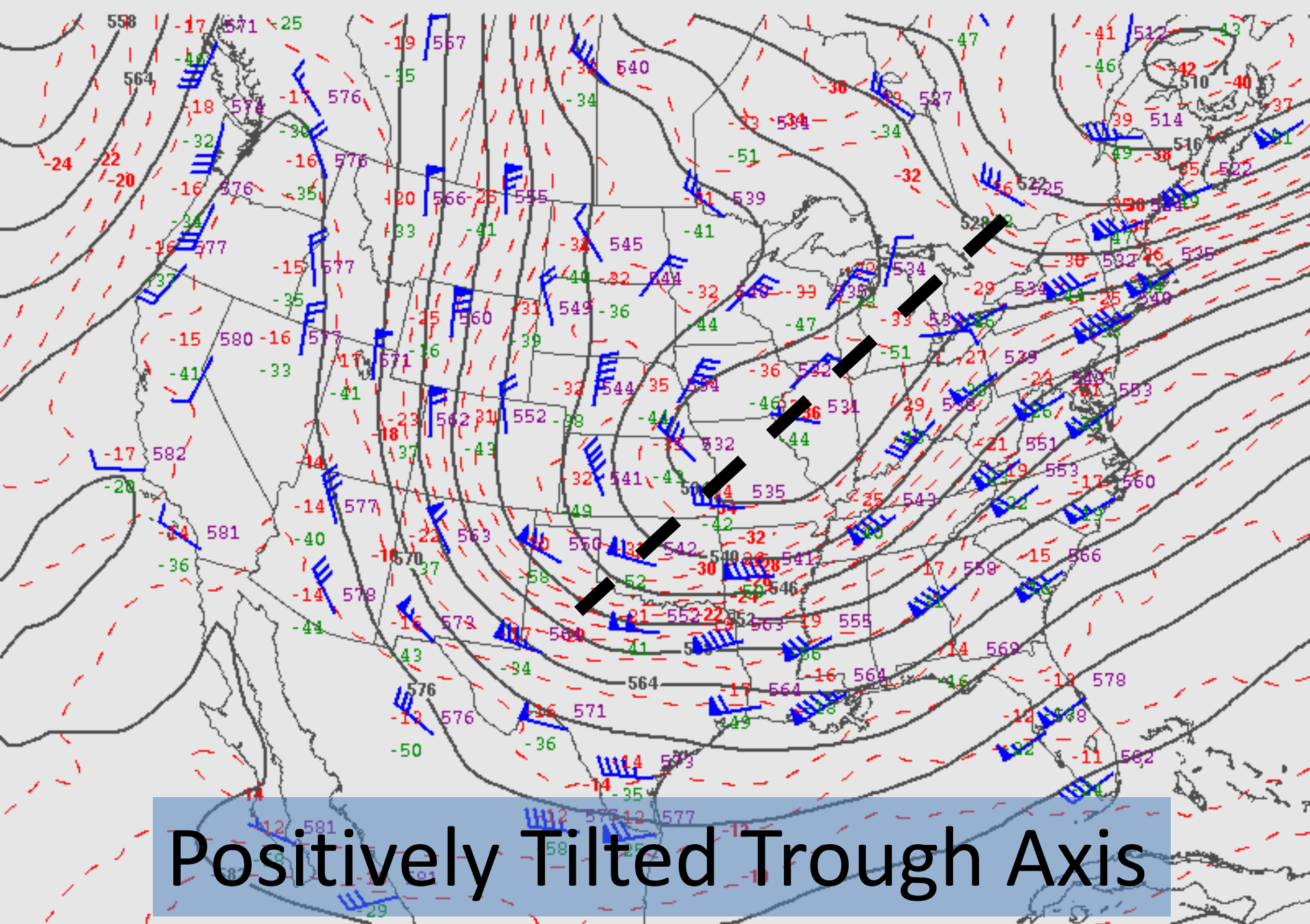


Cold Front



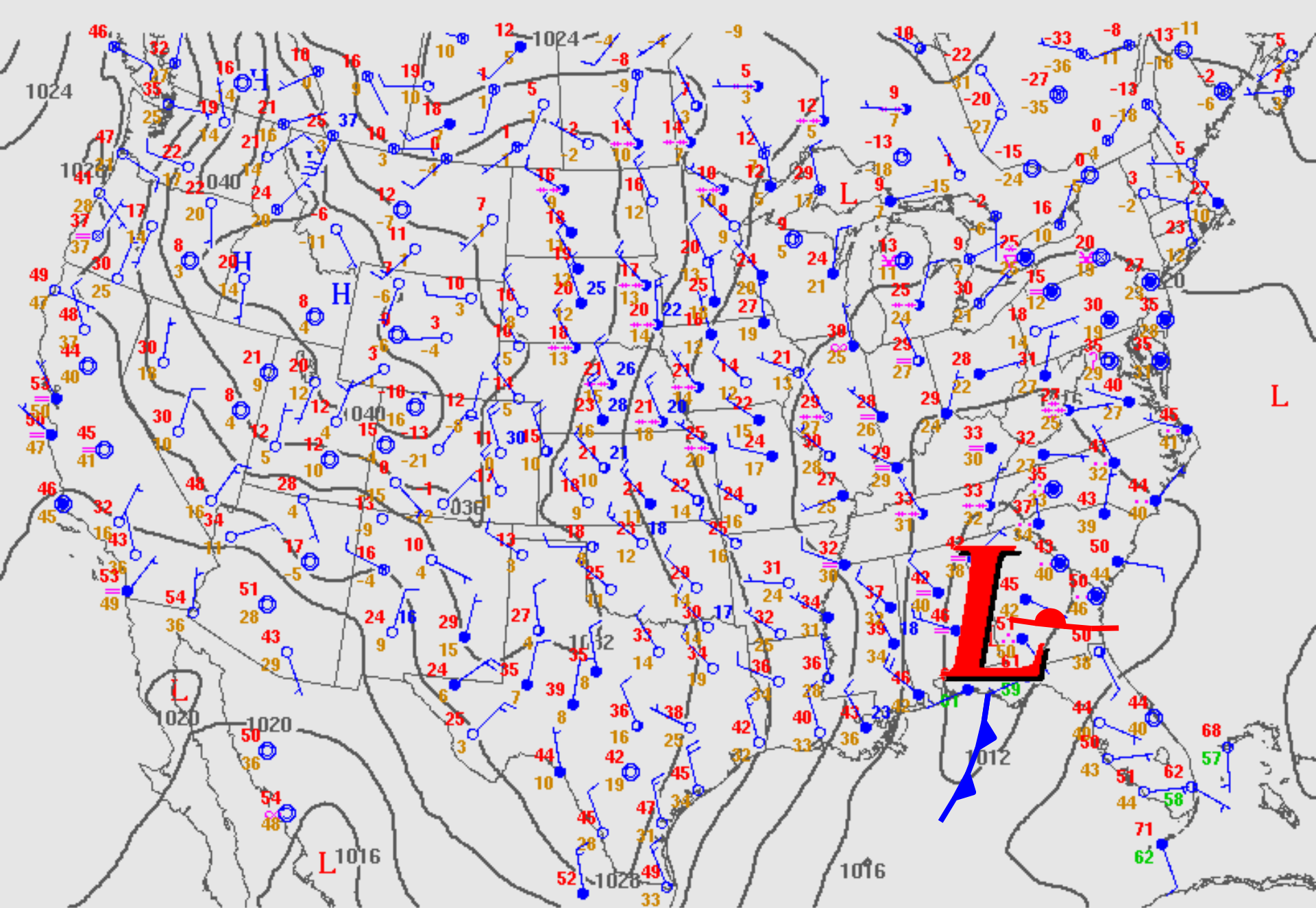
# Synoptic Weather Patterns: The Low Pressure System

Why are some systems  
stronger than others?

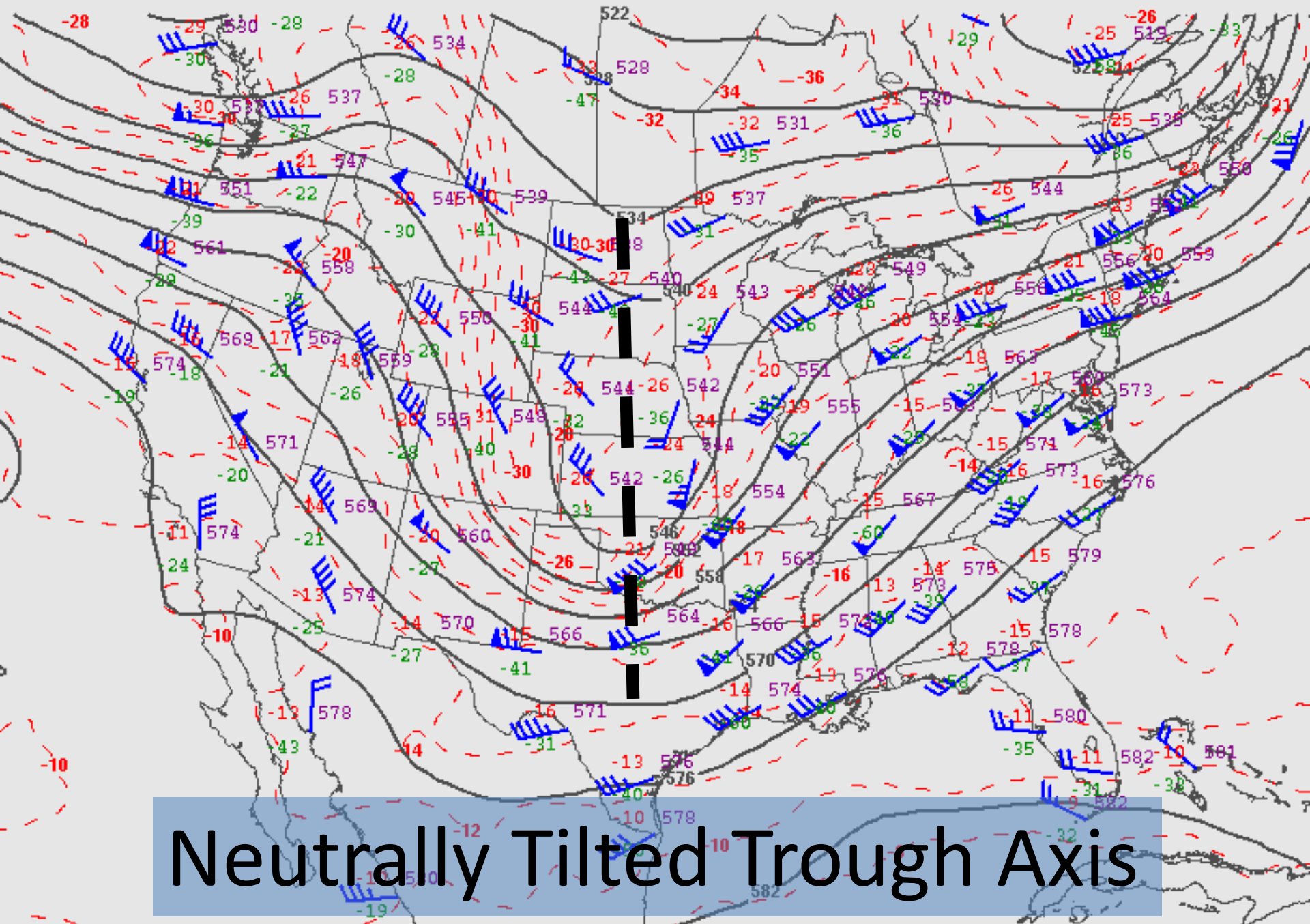


Positively Tilted Trough Axis



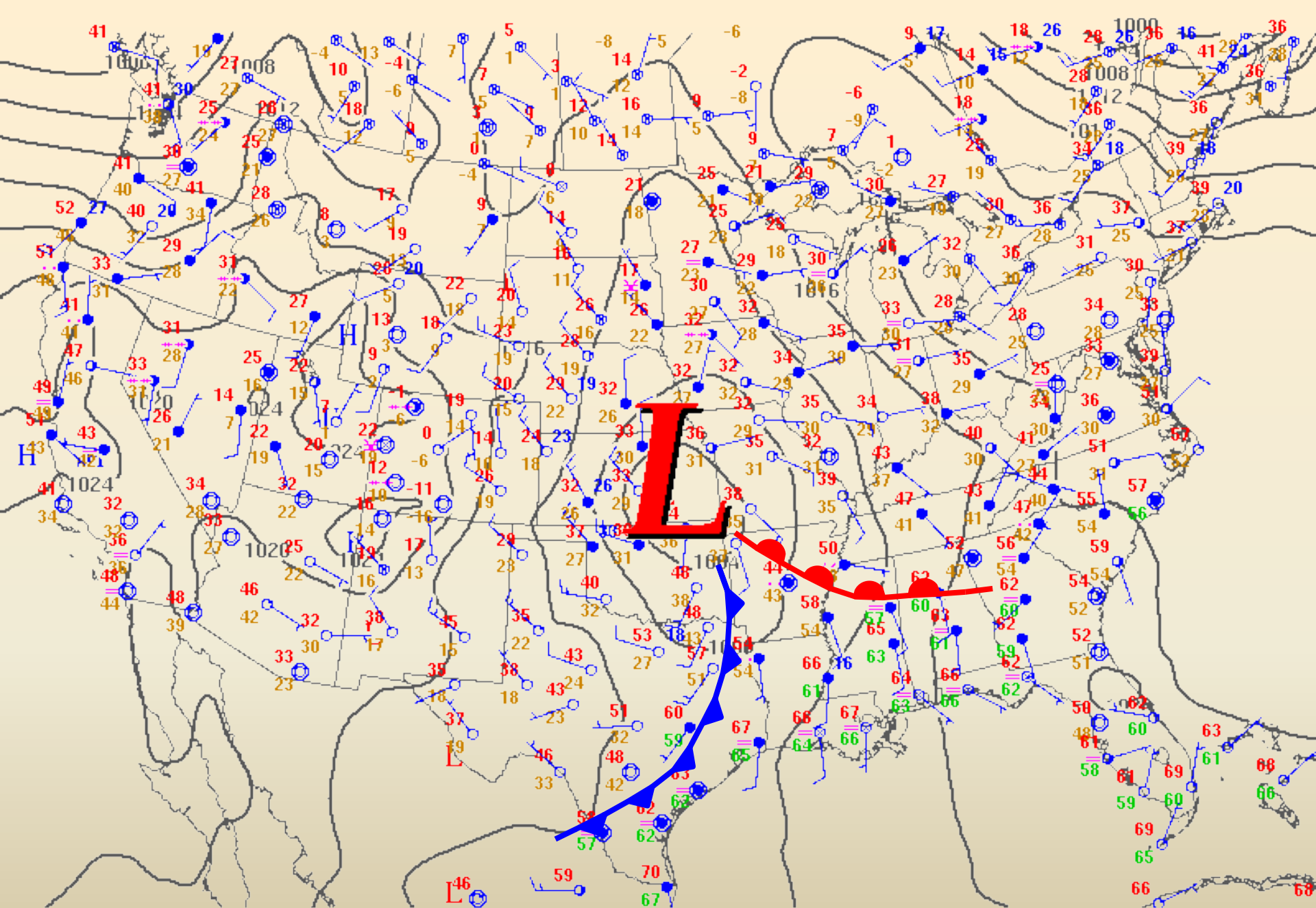


060211/1200 Surface OA Pressure and Obs  
Weather, Temp, Dwp't, Gusts

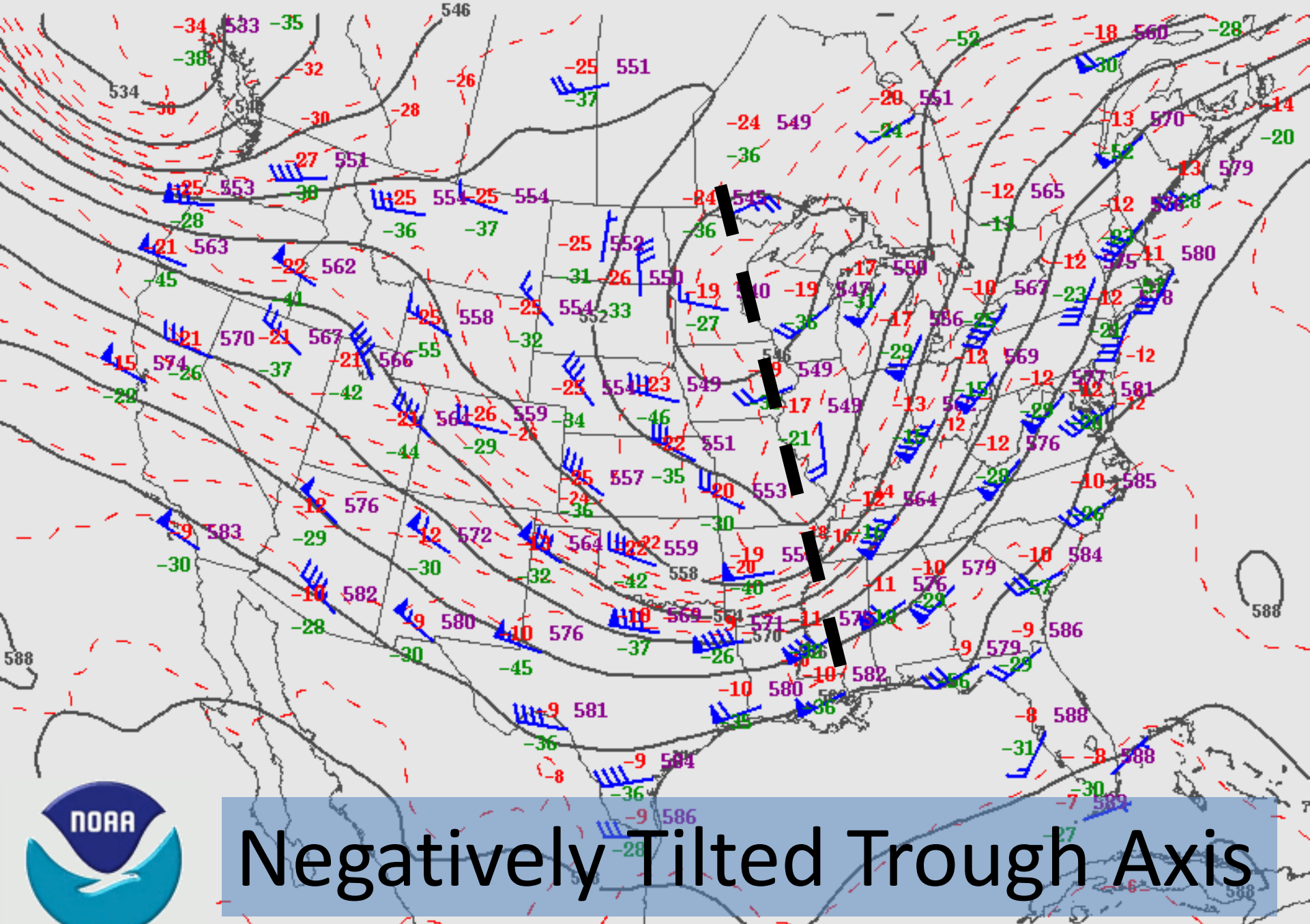


Neutrally Tilted Trough Axis



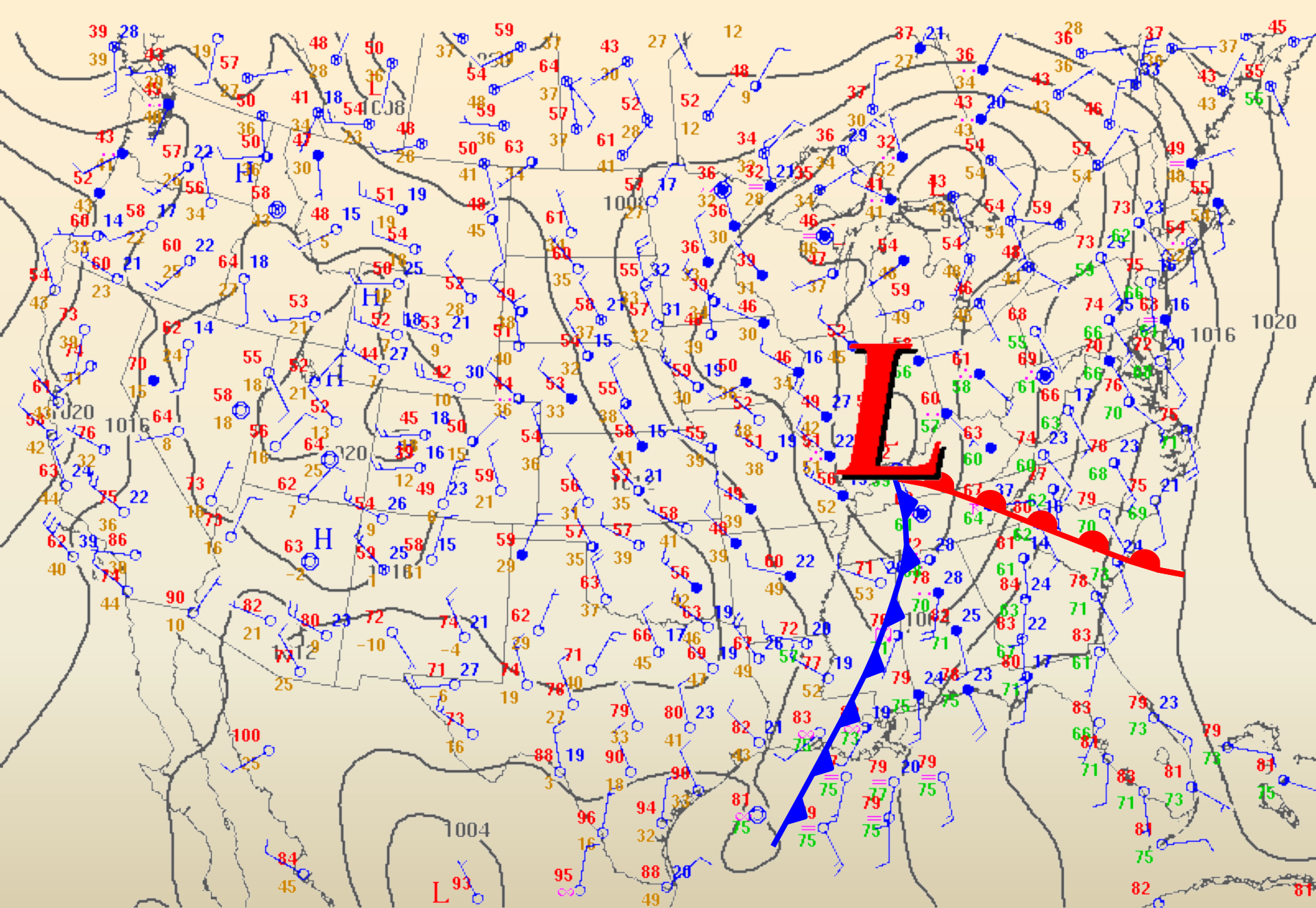


080110/1200 Surface OA Pressure and Obs  
Weather, Temp, Dwp, Gusts



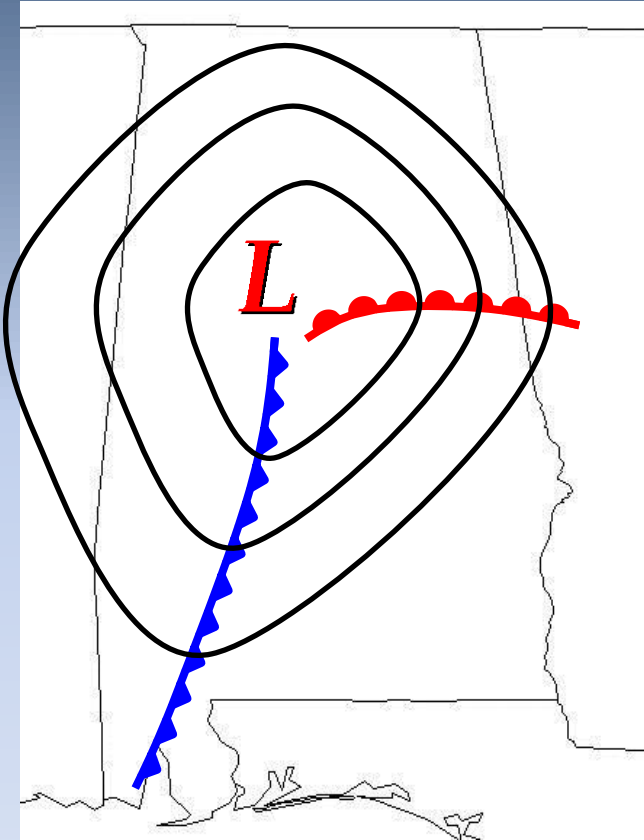
# Negatively Tilted Trough Axis





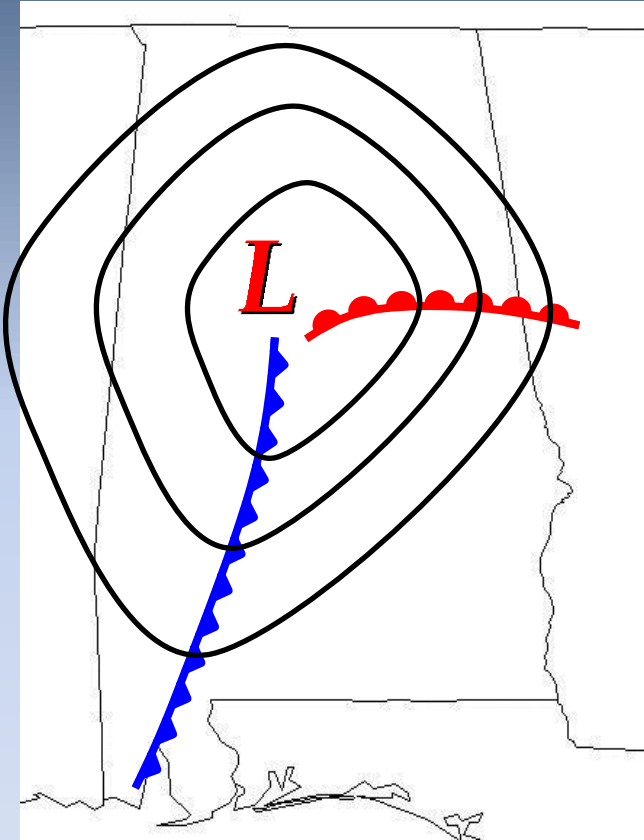
110428/0000 Surface OA Pressure and Obs  
Weather, Temp, Dwp, Gusts

# Synoptic Weather Patterns: The Schematics to Getting Thunderstorms



3 Main Ingredients to  
get thunderstorms  
fired up

# Synoptic Weather Patterns: The Schematics to Getting Thunderstorms

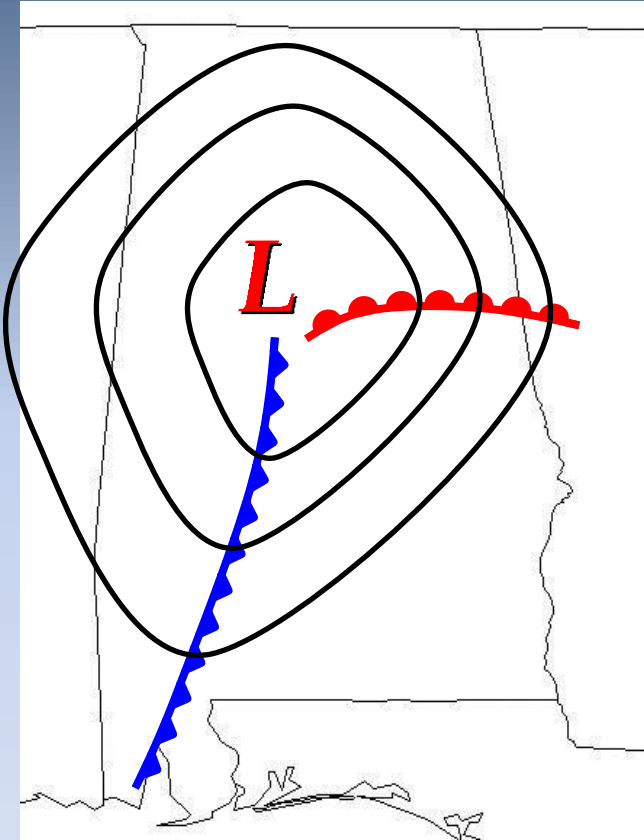


## 3 Main Ingredients

- Moisture
  - Warm Front



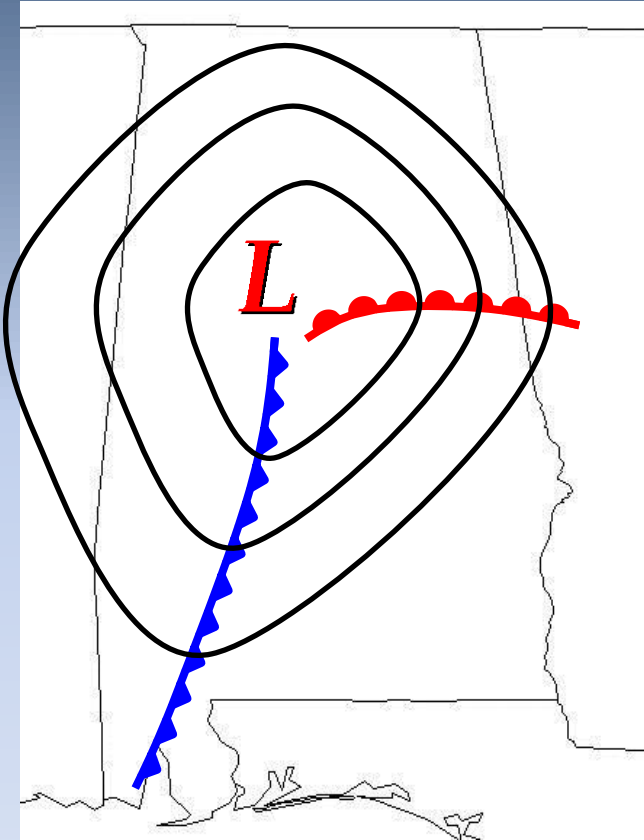
# Synoptic Weather Patterns: The Schematics to Getting Thunderstorms



## 3 Main Ingredients

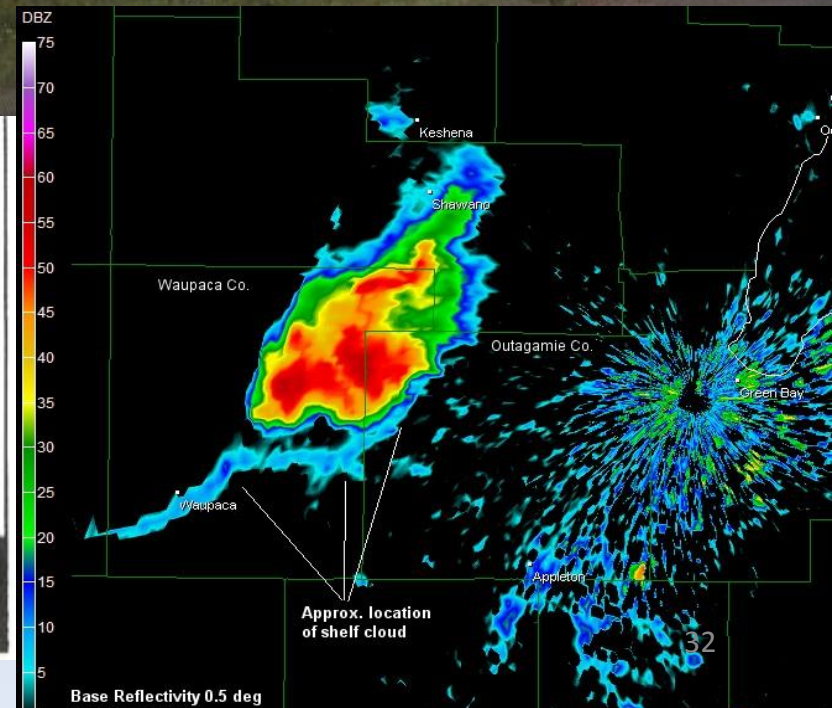
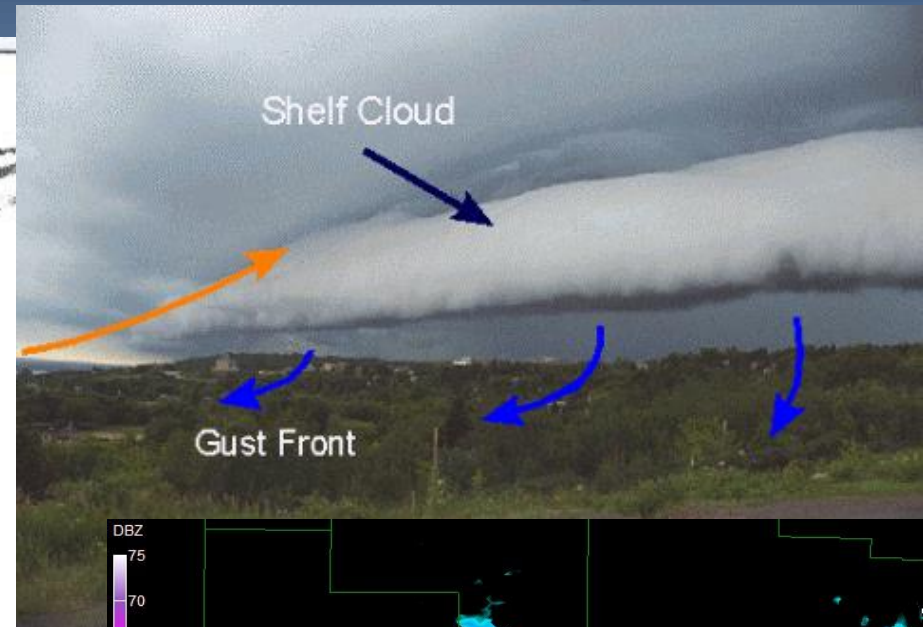
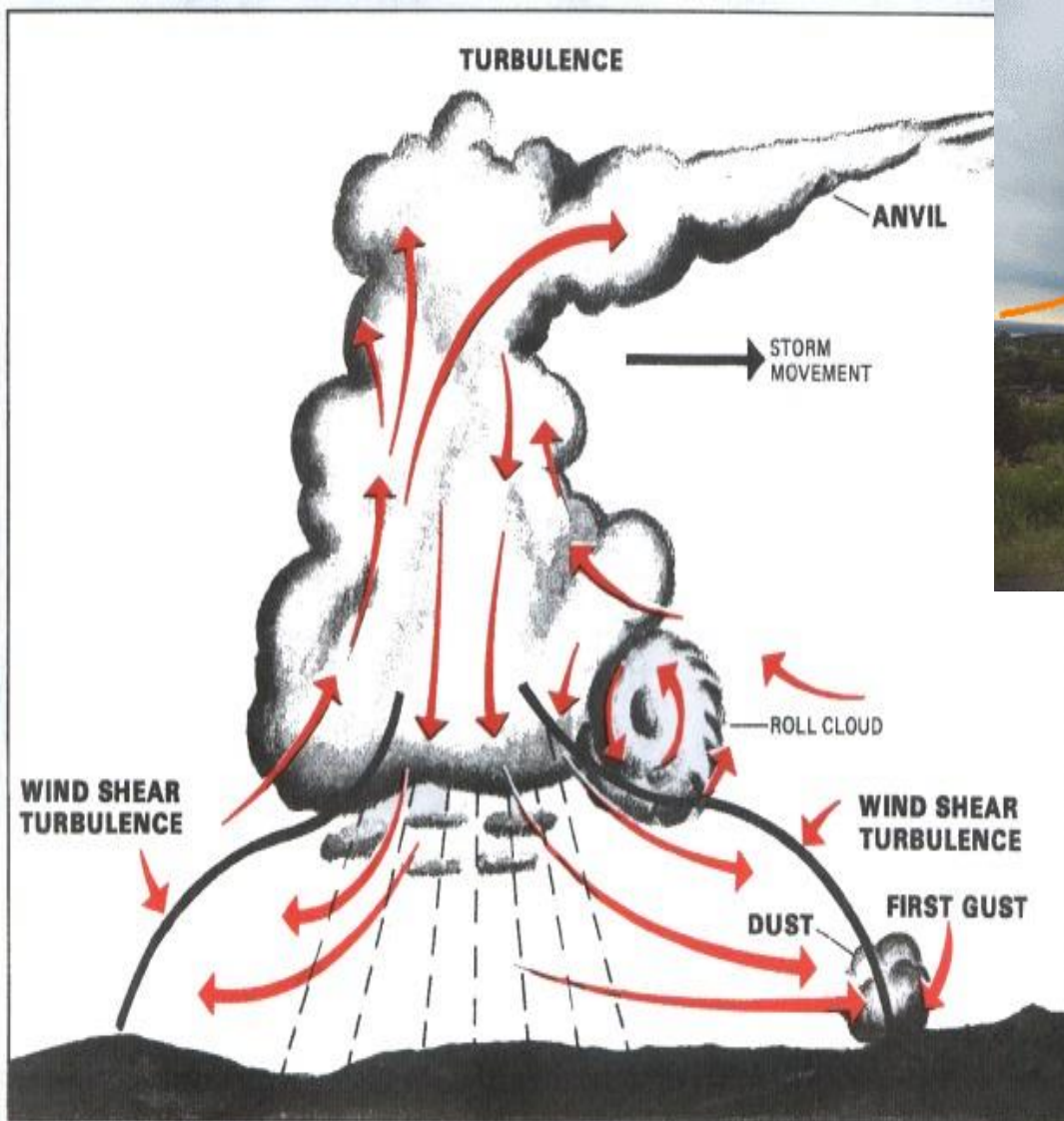
- Moisture
  - Warm Front
- Lift Mechanism
  - Cold Front
  - Warm Front

# Synoptic Weather Patterns: The Schematics to Getting Thunderstorms

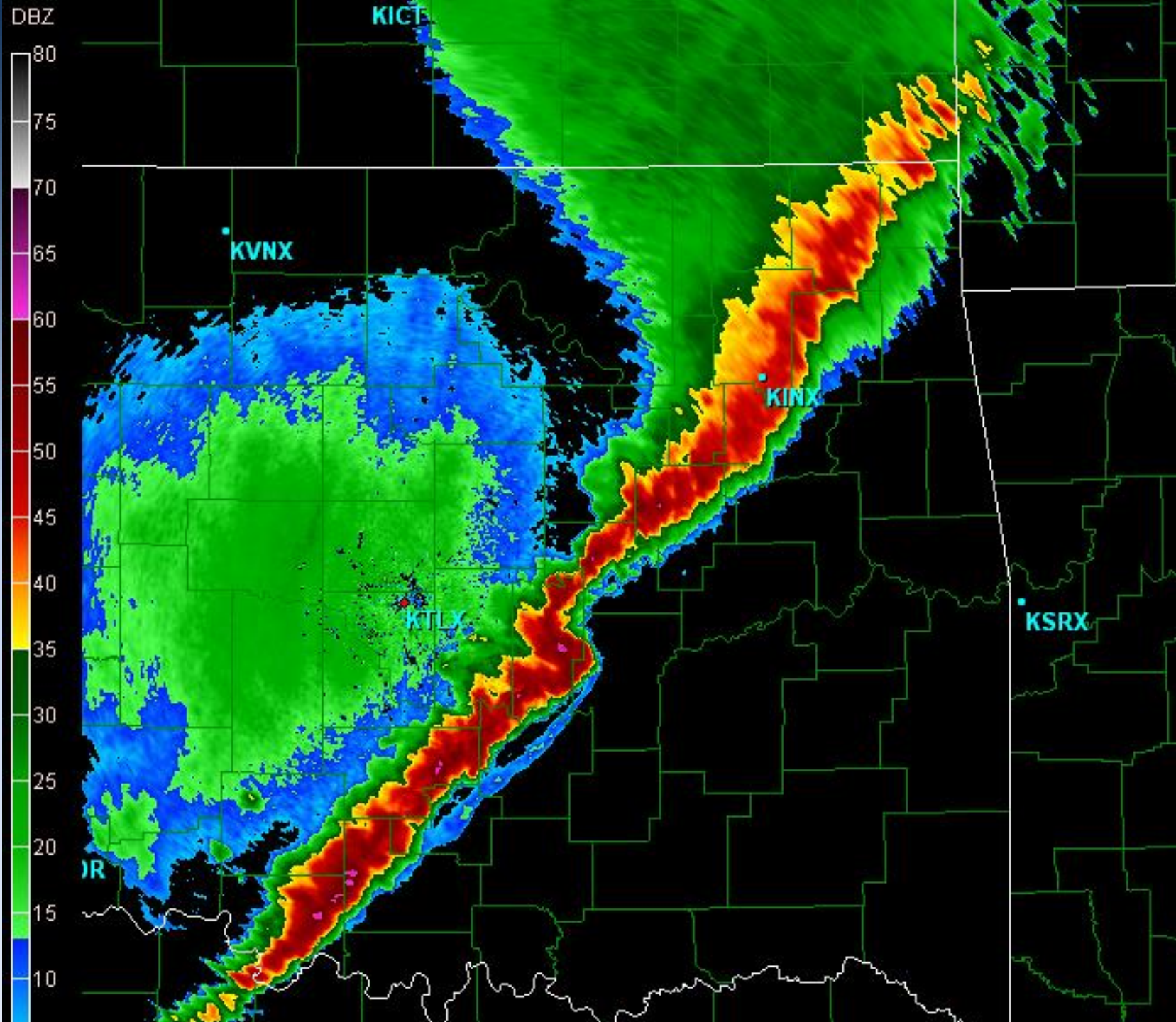


- 3 Main Ingredients
- Moisture
    - Warm Front
  - Lift Mechanism
    - Other Types of Boundaries

# The 3-Dimensional Atmosphere Gust Front (other sources of lift)





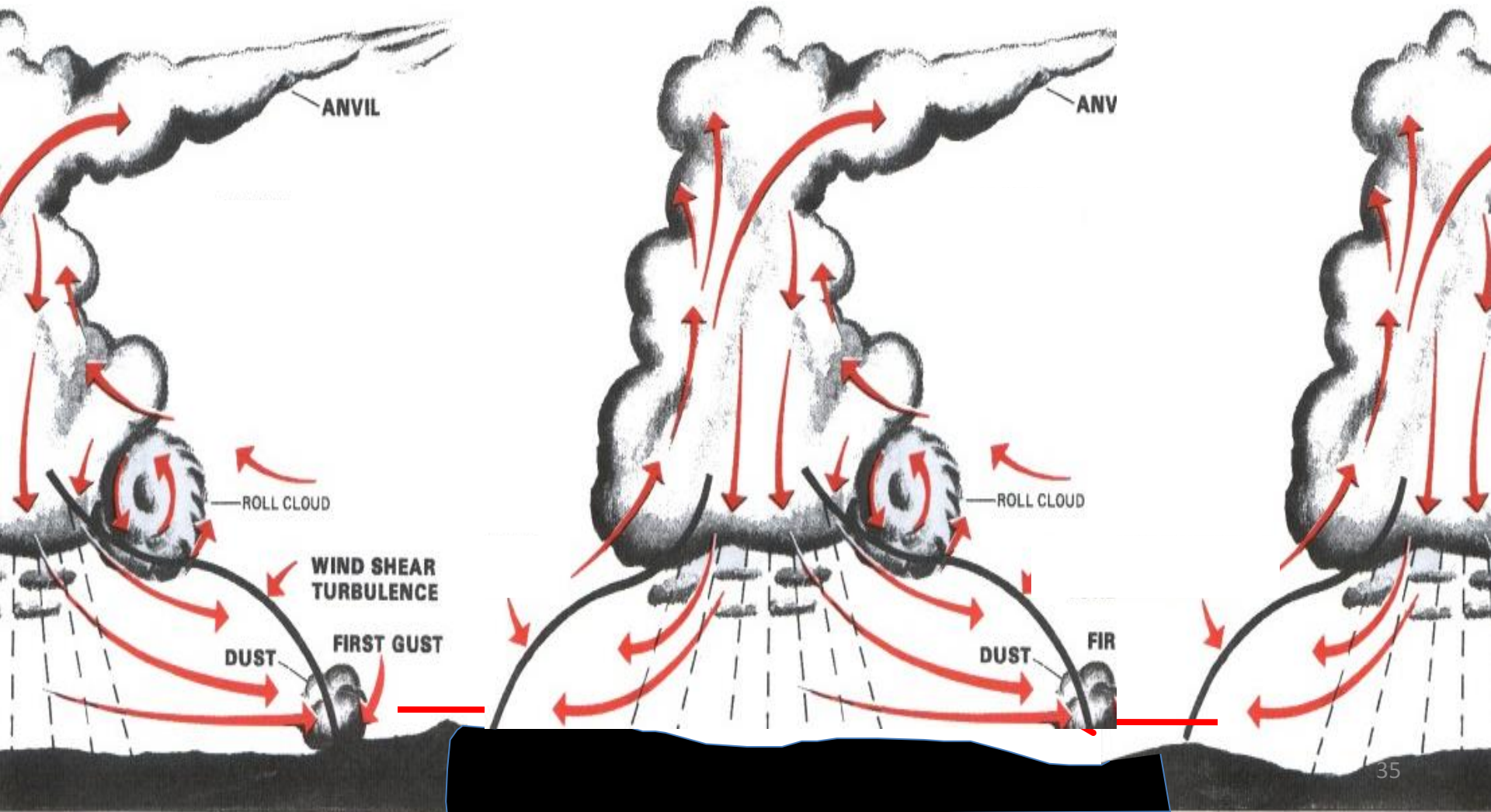




**Tornado Watch # 947 - Valid from 805 PM until 300 AM CST**



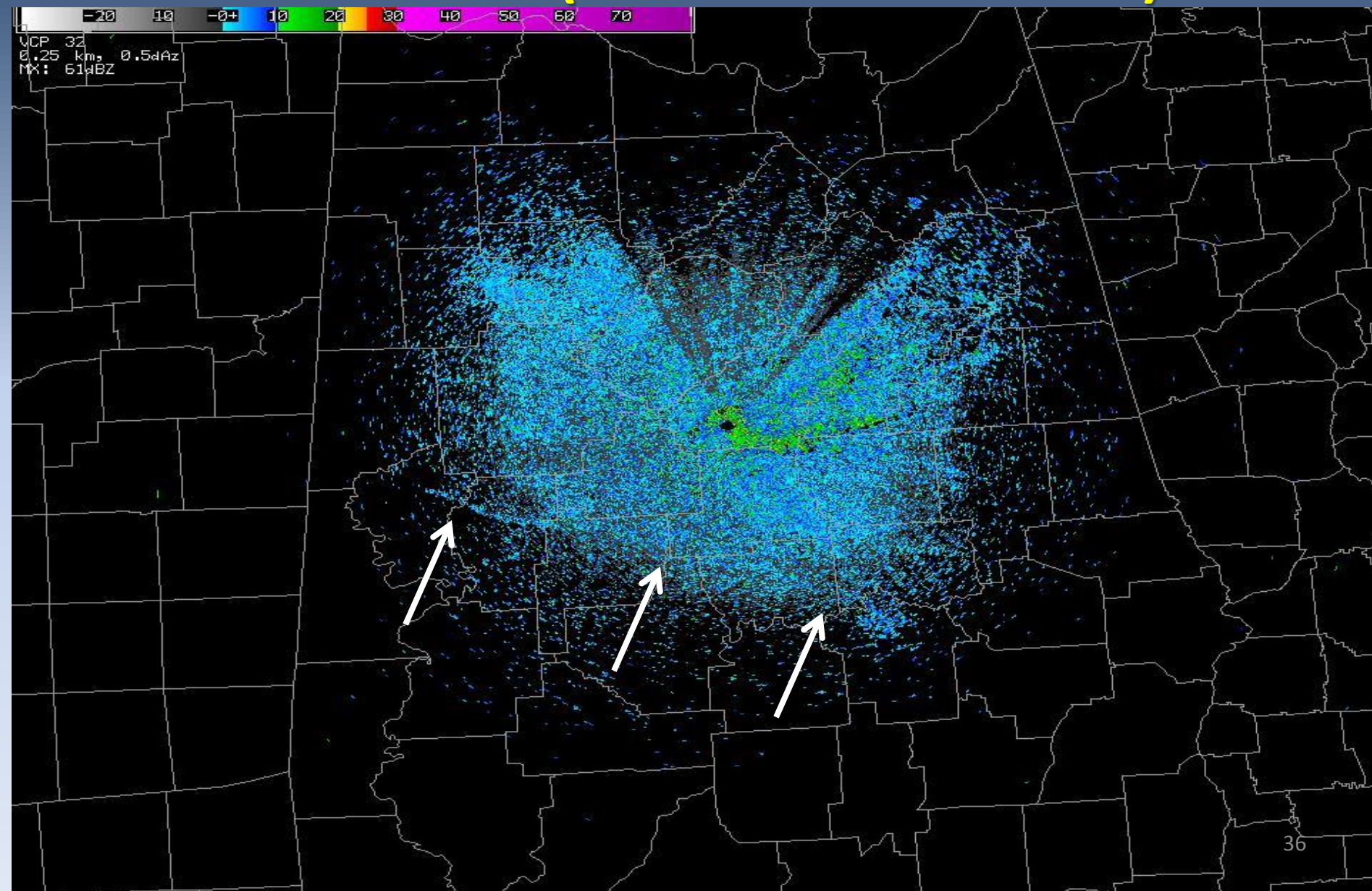
# The 3-Dimensional Atmosphere Gust Front (other sources of lift)





# The 3-Dimensional Atmosphere

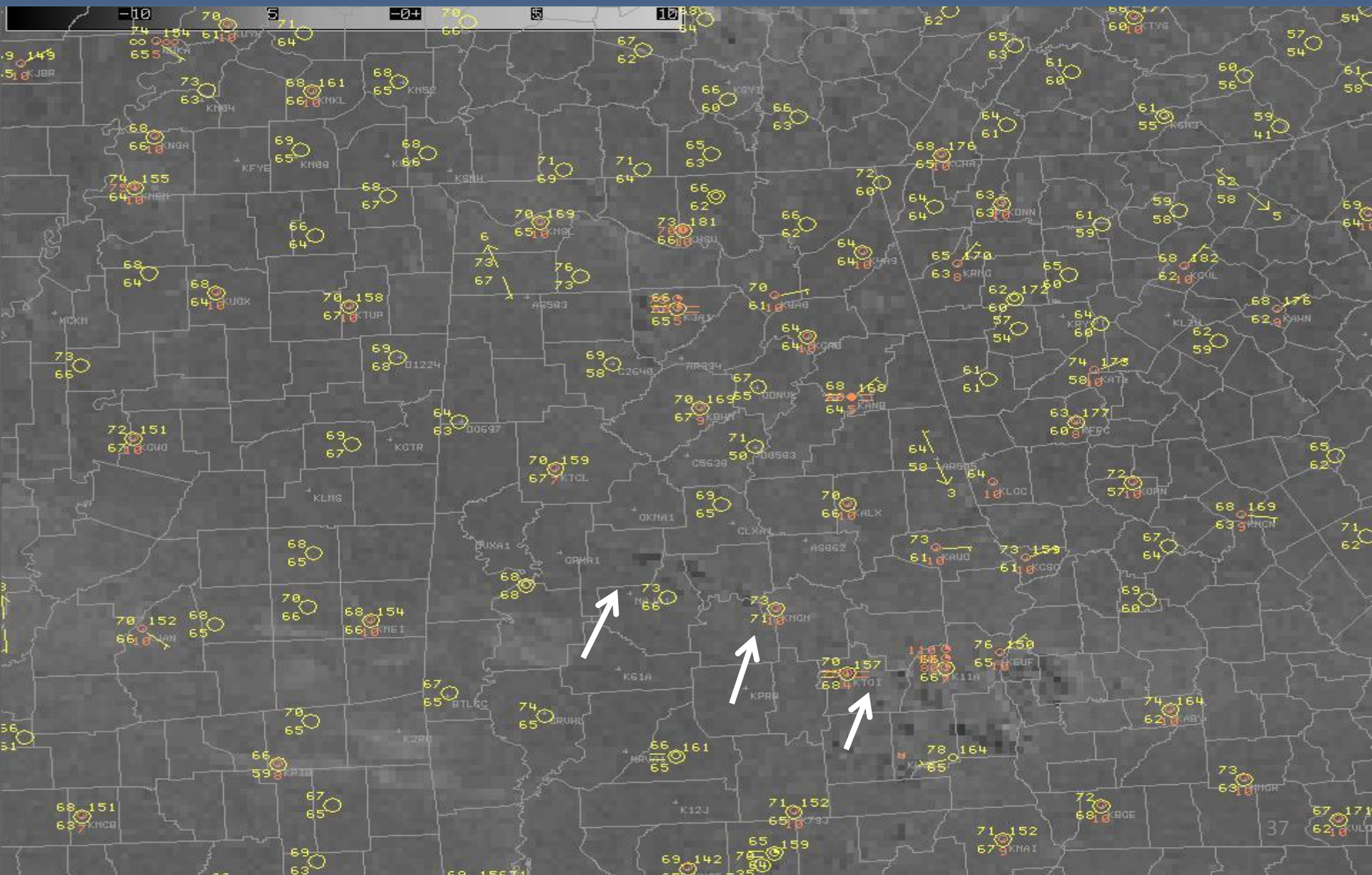
## Sea Breeze (other sources of lift)





# The 3-Dimensional Atmosphere

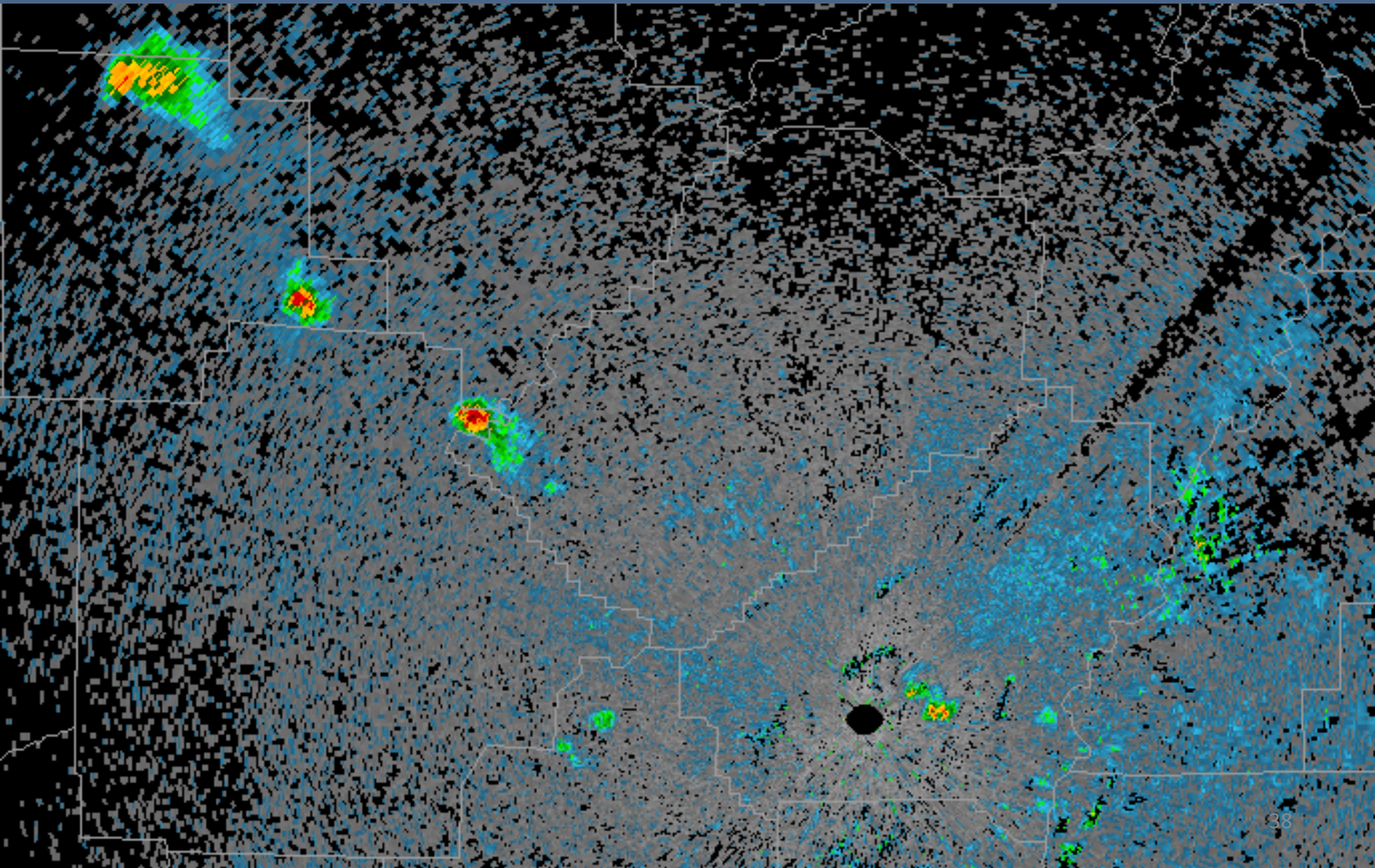
## Sea Breeze





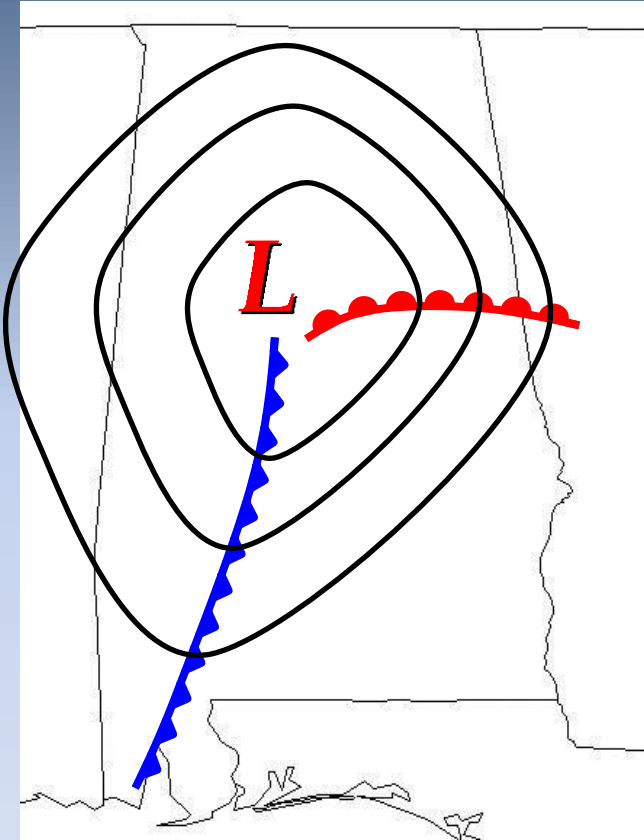
# The 3-Dimensional Atmosphere

## Thunderstorms caused by Sea Breeze





# Synoptic Weather Patterns: The Schematics to Getting Thunderstorms



## 3 Main Ingredients

- Moisture
- Lift Mechanism
- **Instability**

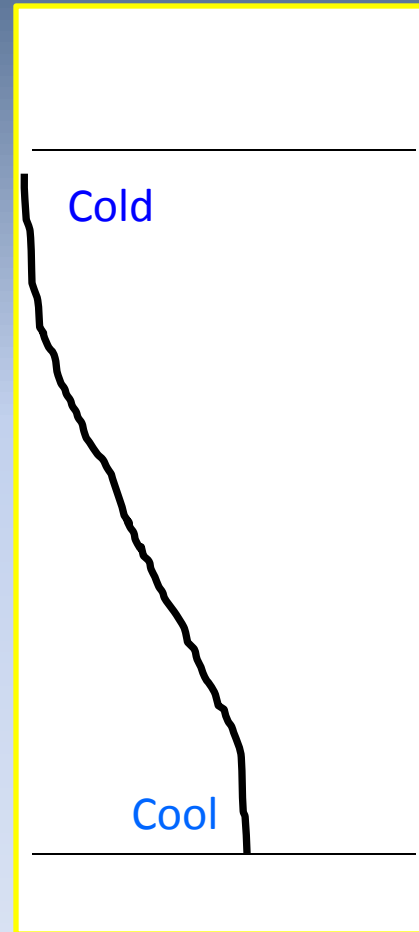
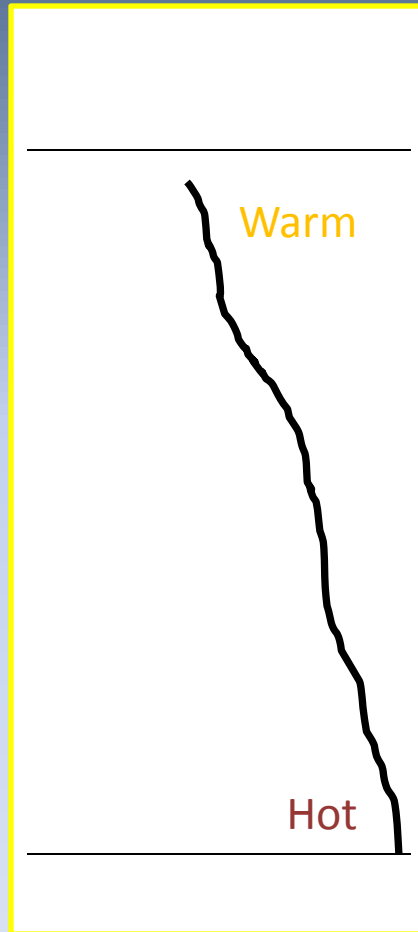
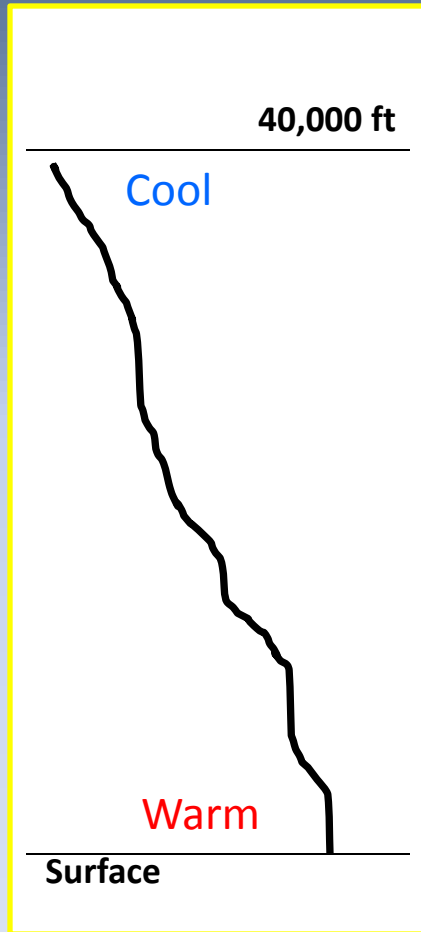
# The 3-Dimensional Atmosphere Instability




## General

## Summer

## Winter



- In basic terms, the instability of the atmosphere is measured based upon how warm it is at the surface versus how cold it is aloft.
- In general, the atmosphere gets colder as you go up.
- During the summer, it is a lot hotter at the surface, but it also warm aloft
- In the winter it is colder at the surface, but it is also colder in the upper atmosphere, as well.

Temperature   
Increasing

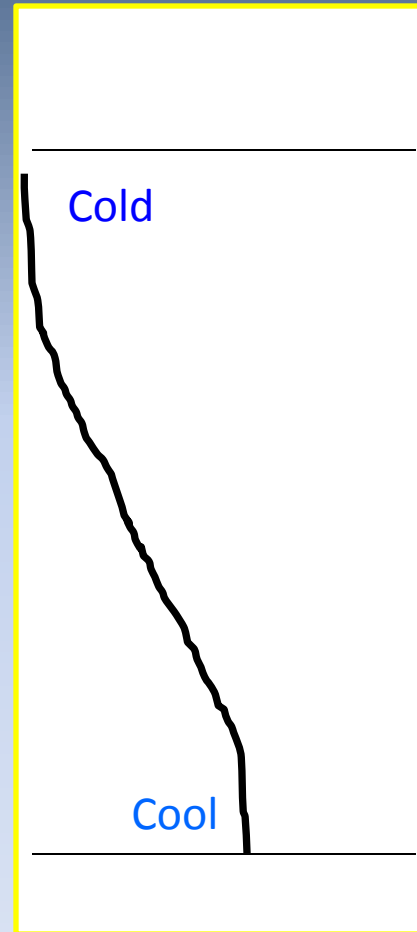
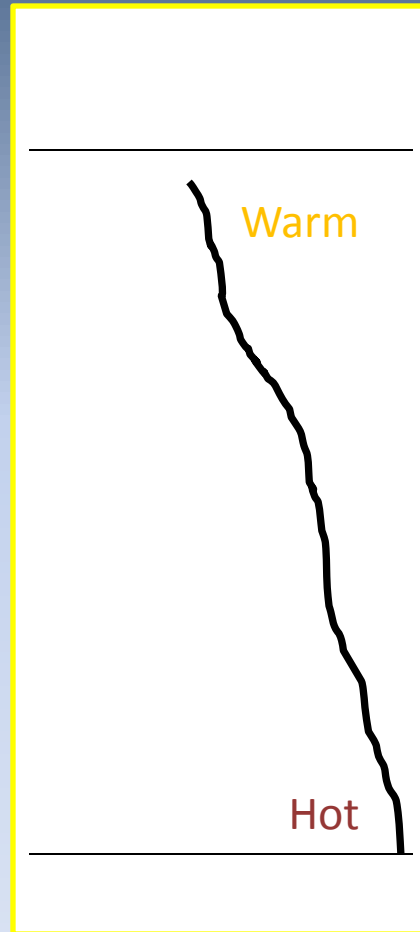
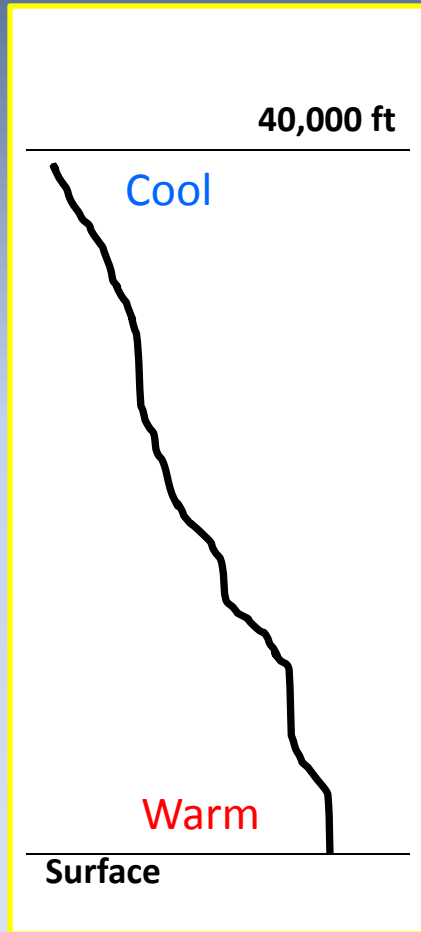
# The 3-Dimensional Atmosphere Instability




## General

## Summer

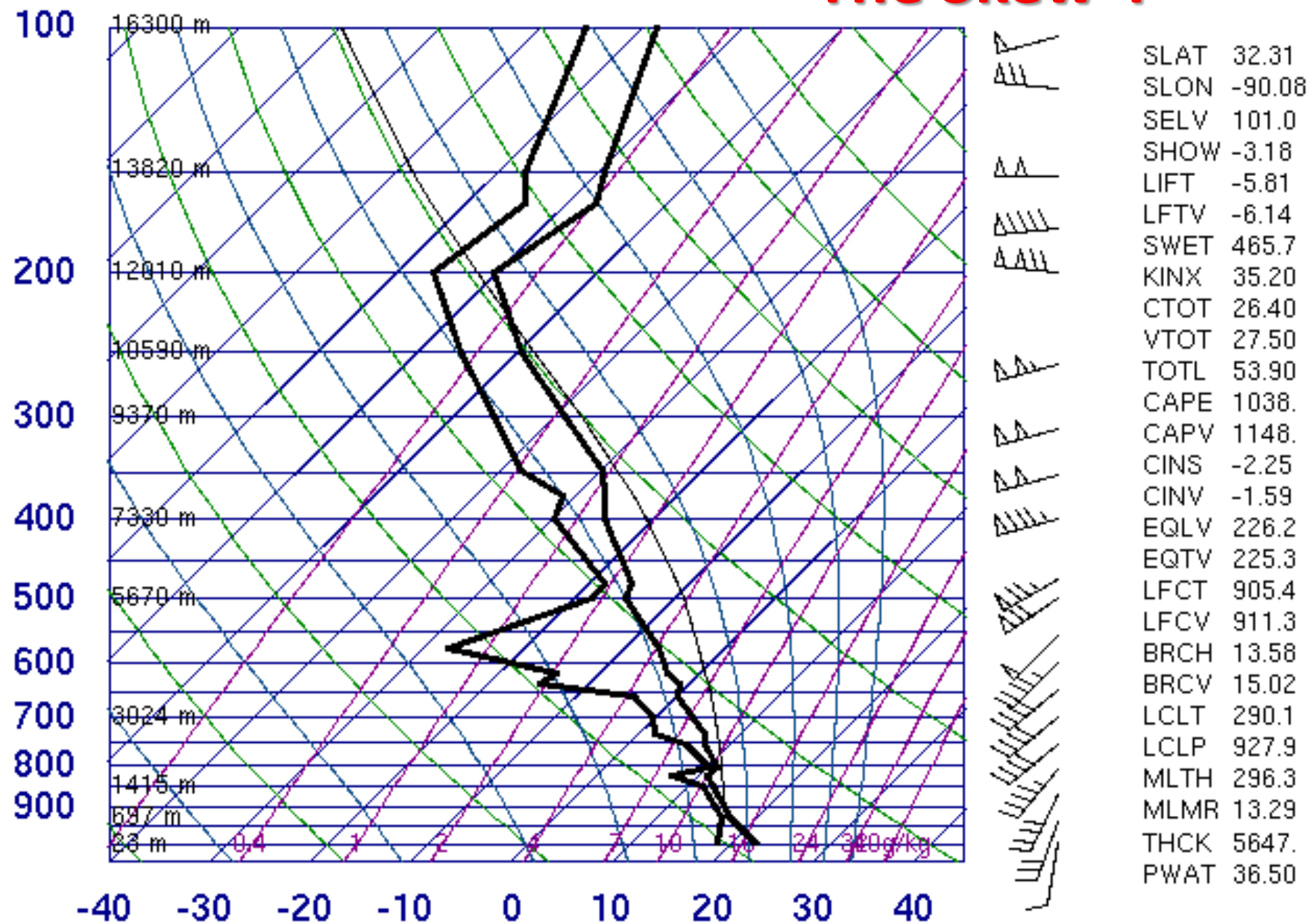
## Winter



- In basic terms, the instability of the atmosphere is measured based upon how warm it is at the surface versus how cold it is aloft.
- In general, the atmosphere gets colder as you go up.
- During the summer, it is a lot hotter at the surface, but it also warm aloft
- In the winter it is colder at the surface, but it is also colder in the upper atmosphere, as well.
- **How is the instability calculated?**

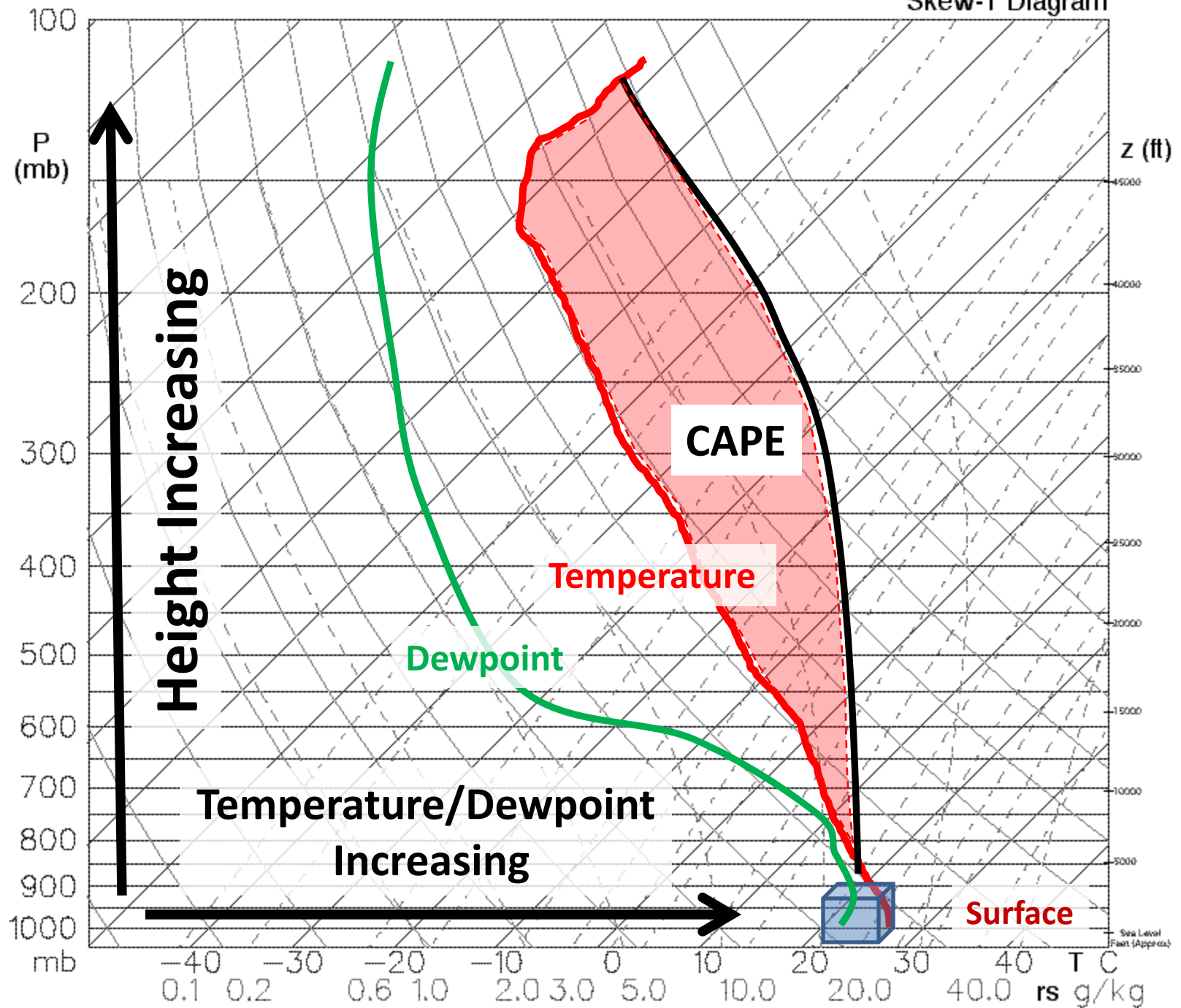
Temperature   
Increasing





# Weather Balloon Launches

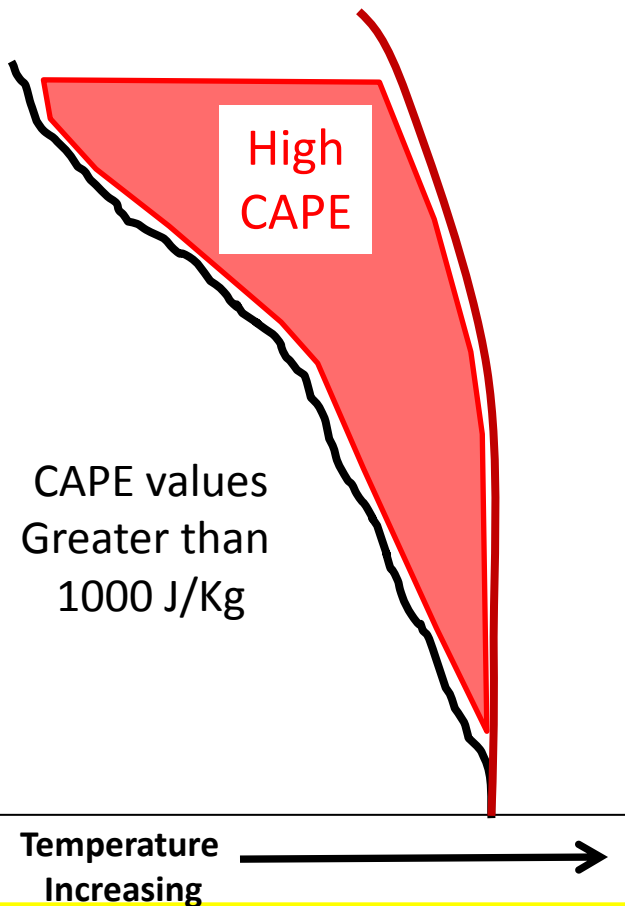




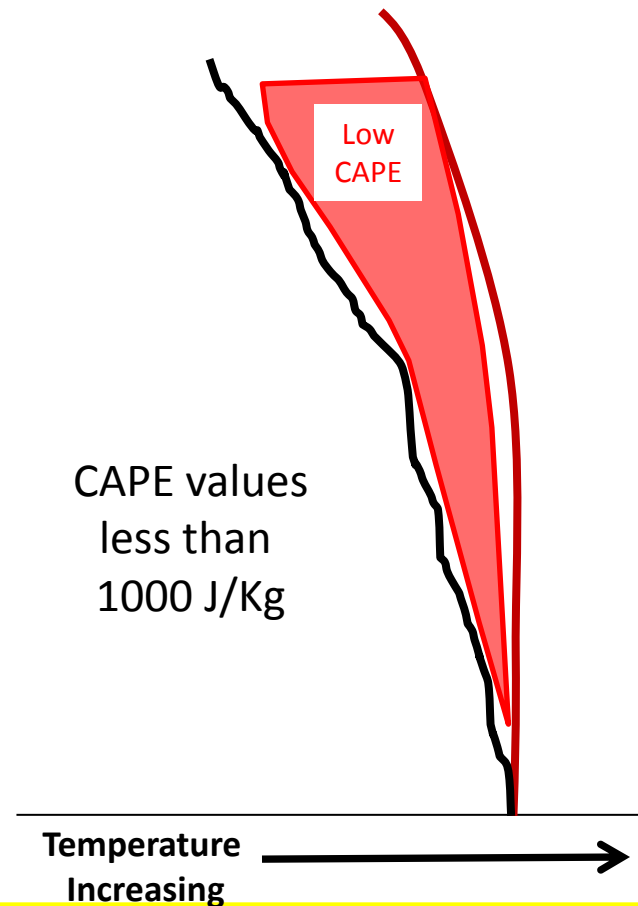


# The 3-Dimensional Atmosphere Instability

## Hot Surface/Cold Aloft

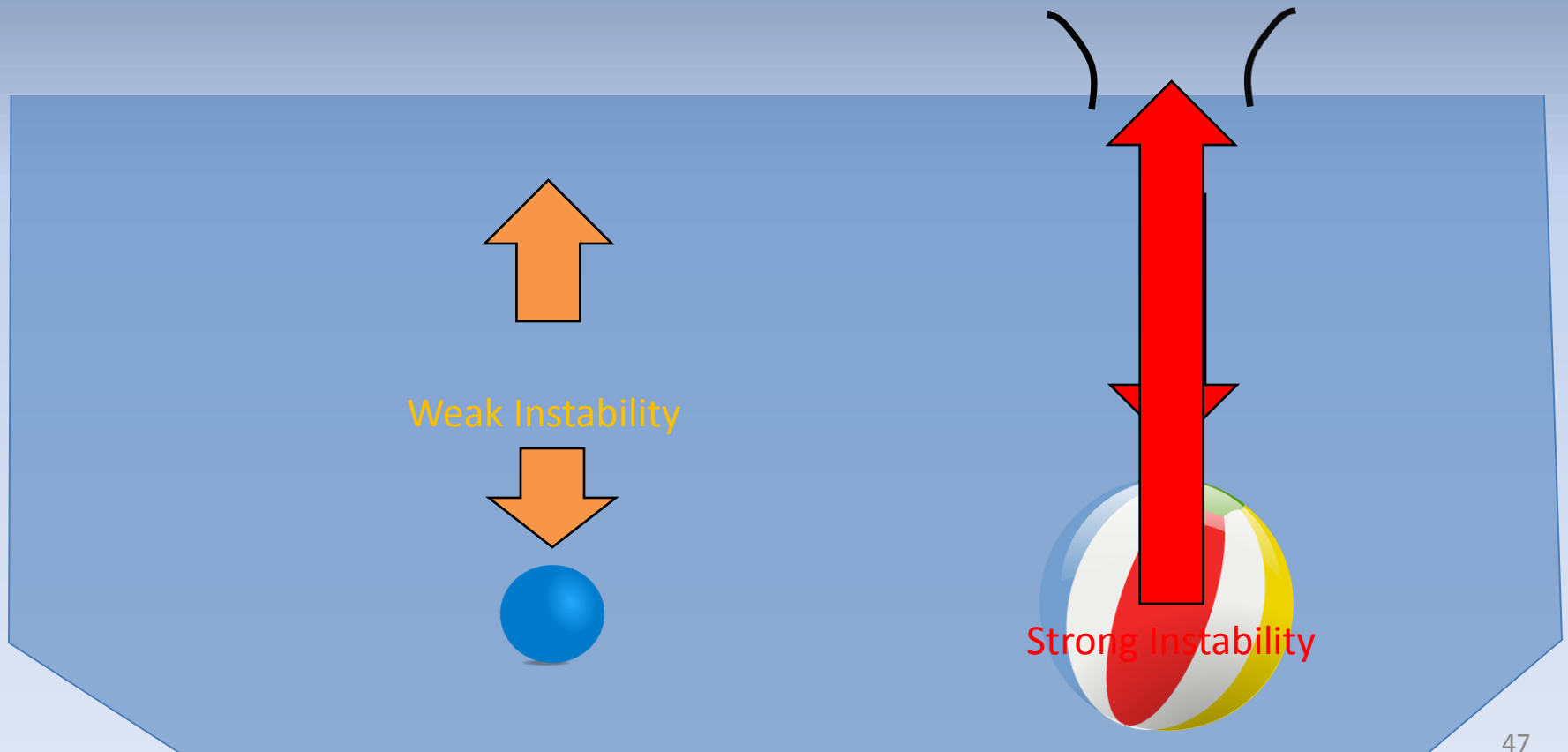


## Hot Surface/Warm Aloft



- CAPE stands for the **C**onvective **A**vailable **P**otential **E**nergy
- Depending on what type of CAPE exists (tall, short, skinny, fat) will determine the type and amount of thunderstorms that are possible (potential).

# The 3-Dimensional Atmosphere Instability





NOAA's National Weather Service

# Storm Prediction Center

Site Map

News

Organization

Local forecast by

"City, St" or "ZIP"

City, St  Go

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SPC FAQ

About Tornadoes

About Derechos

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Enh. Fujita Page

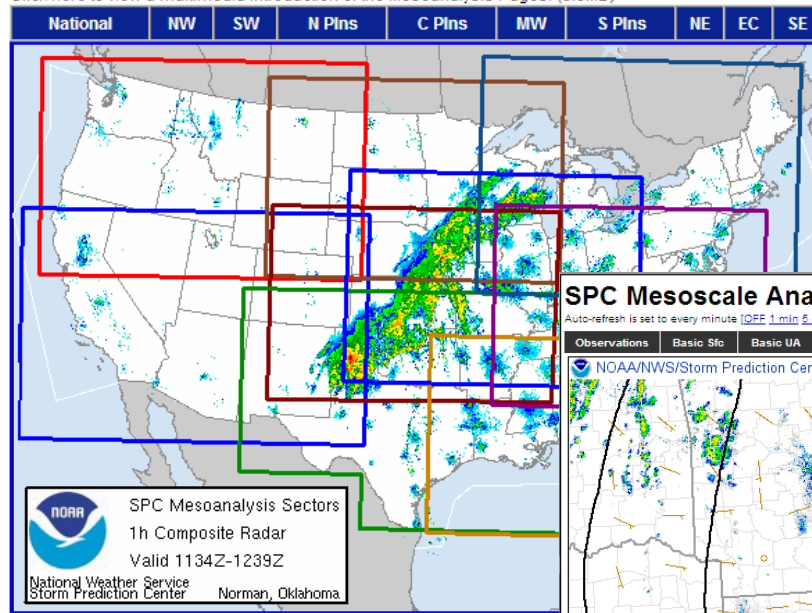
Cool Images

Our History

Public Affairs

## SPC Mesoscale Analysis Pages [\(National Sector Archive\)](#) [| Mobile Version](#)

Click [here](#) to view a multimedia introduction of the Mesoanalysis Pages. (5.8MB)



These 10 fixed sectors can be used to see regional gridded mesoanalysis. This information is provided by SPC as a way of sharing the techniques with local forecasters.

## SPC Mesoscale Analysis

Auto-refresh is set to every minute [\[OFF\]](#) [1 min](#) [5 min](#)

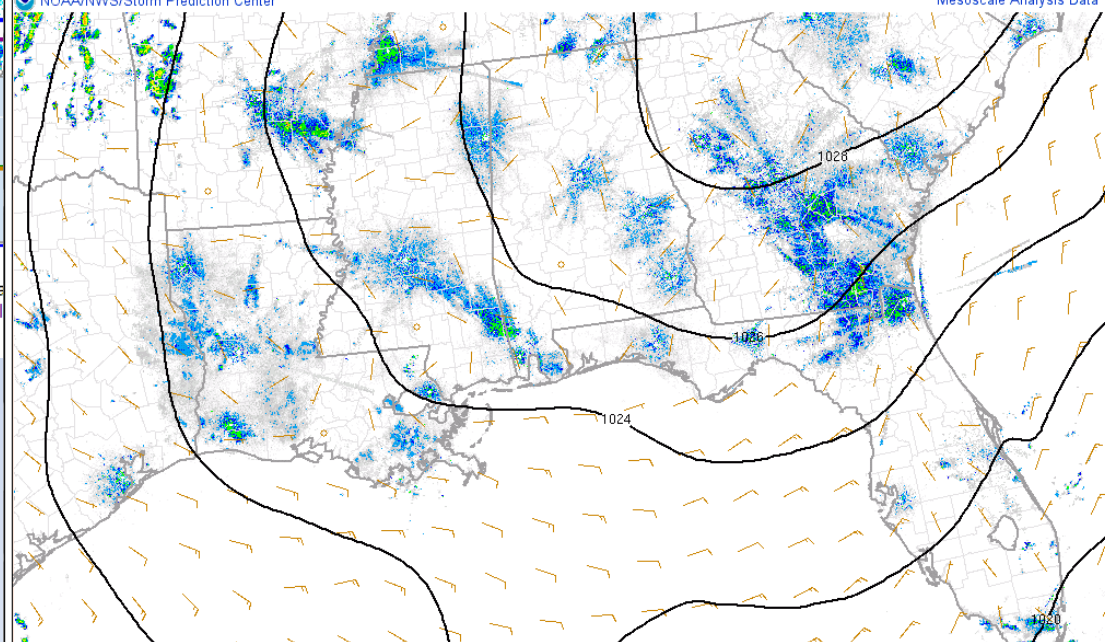
[Change Sector](#) [Recent Image Archive & Loops](#) [SPC Homepage](#) [Mobile Version](#)

Surface: **11/12/10 12 UTC**

RUC: **10111211f001**

[Observations](#) [Basic Sfc](#) [Basic UA](#) [Kinematics](#) [Thermodynamics](#) [Wind Shear](#) [Composite Indices](#) [Multi-Parameter Fields](#) [Heavy Rain](#) [Winter Weather](#) [Fire Weather](#)

[NOAA/NWS/Storm Prediction Center](#) [Mesoscale Analysis Data](#)



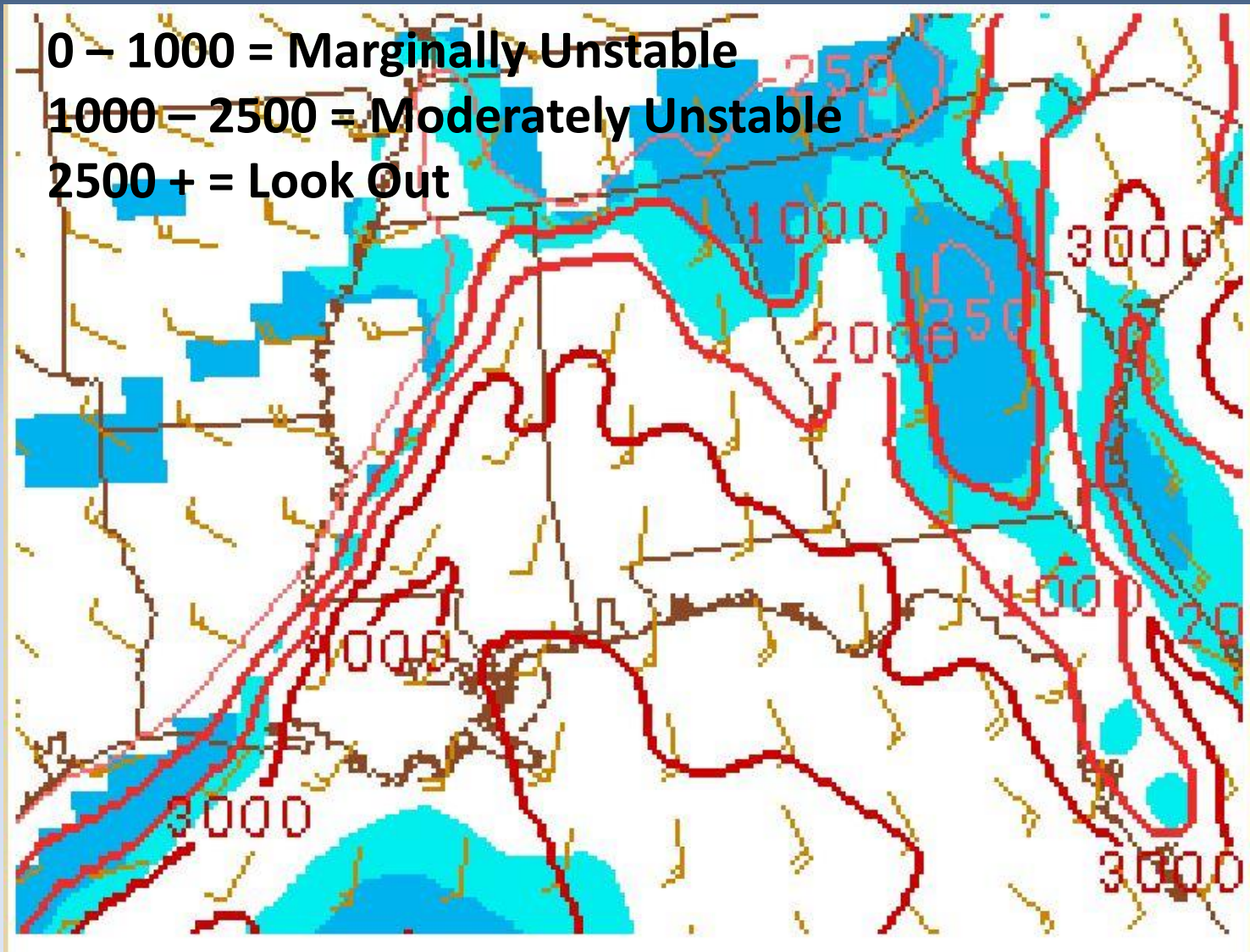


# The 3-Dimensional Atmosphere Instability

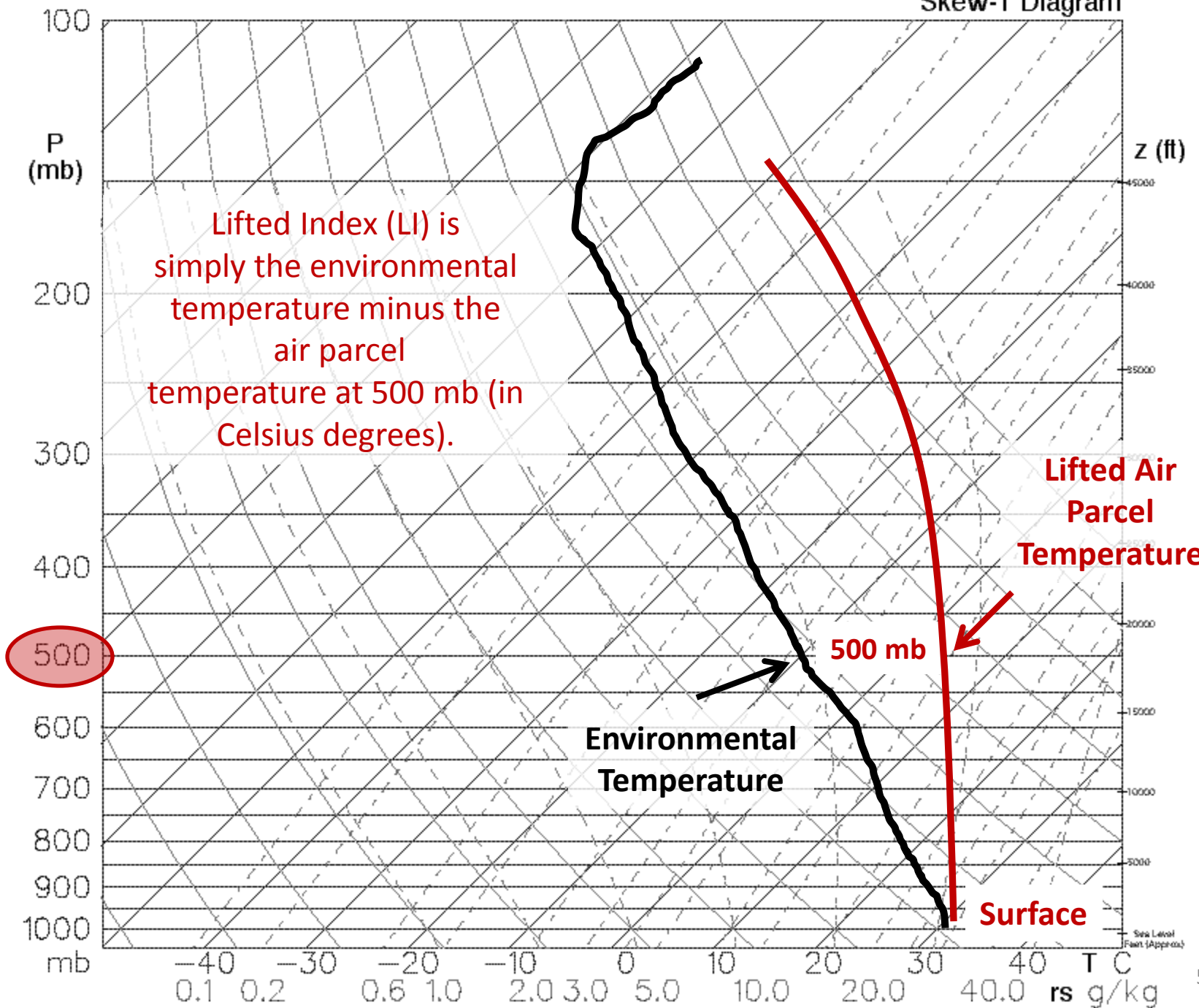
0 – 1000 = Marginally Unstable

1000 – 2500 = Moderately Unstable

2500 + = Look Out

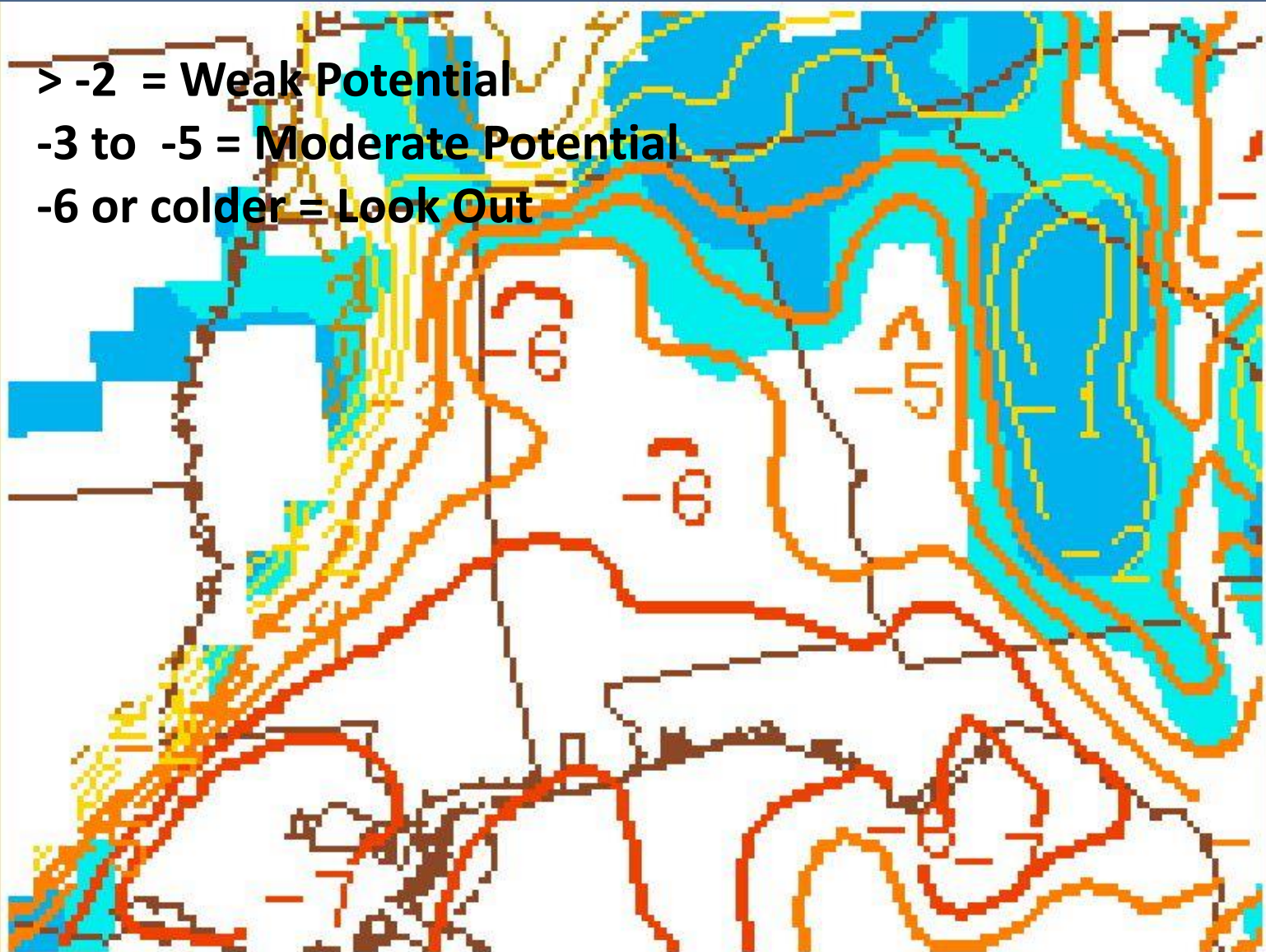


# Skew-T Diagram



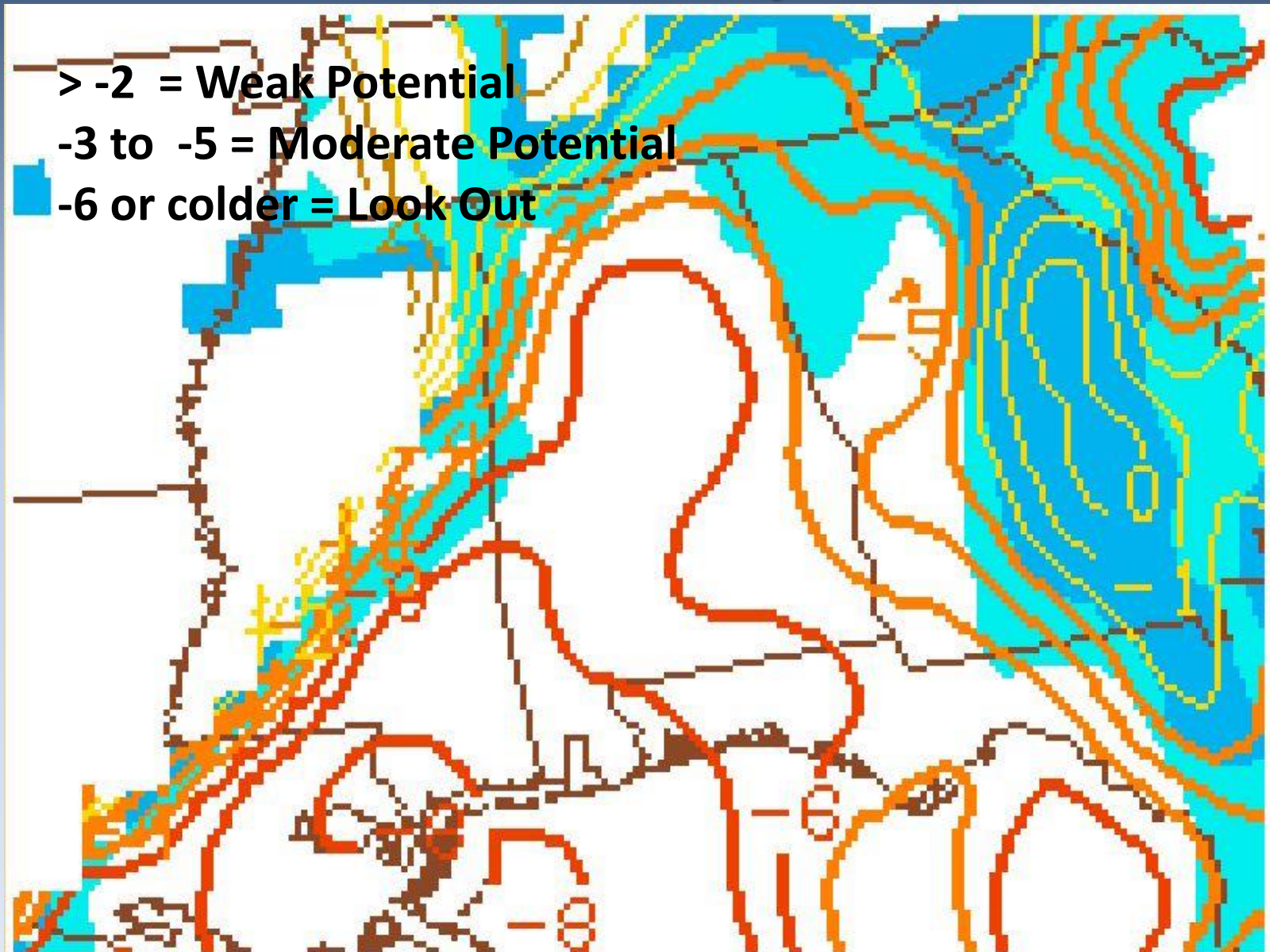
# The 3-Dimensional Atmosphere Instability

- > -2 = Weak Potential
- 3 to -5 = Moderate Potential
- 6 or colder = Look Out

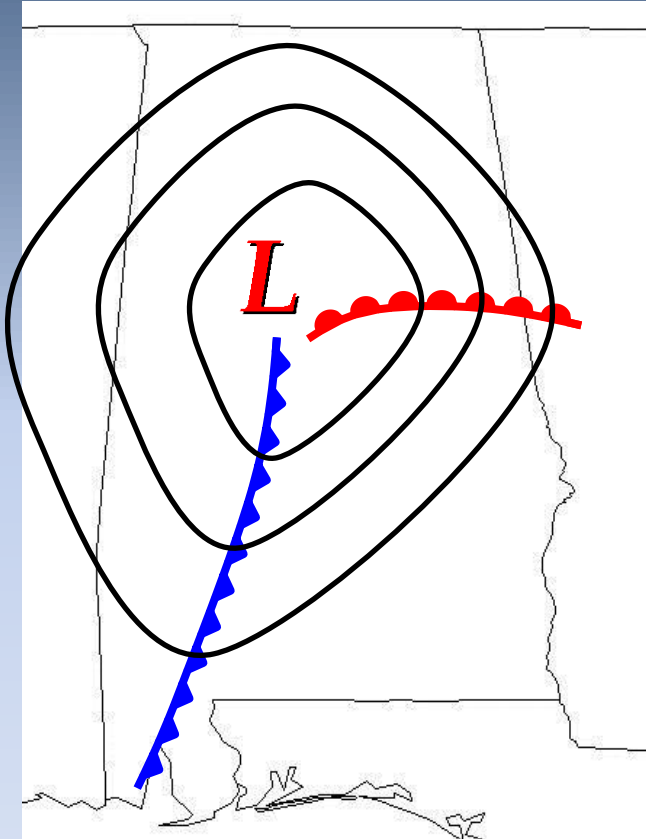




# The 3-Dimensional Atmosphere Instability



# The Schematics to Getting Thunderstorms



## Thunderstorms

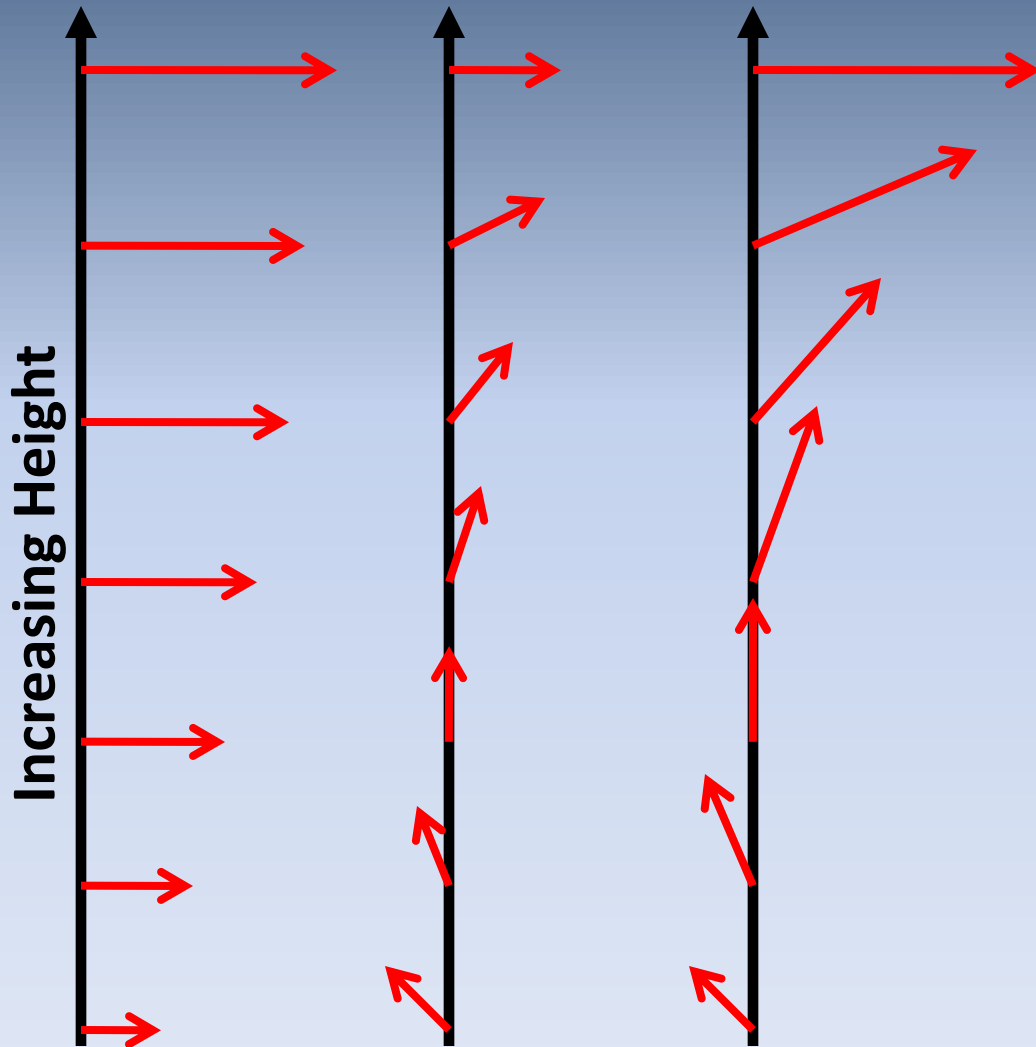
- Instability
- Moisture
- Lift Mechanism

## Severe

- Instability
- Wind Shear

# The 3-Dimensional Atmosphere

## Wind Shear



- Wind shear can be calculated in three ways
- Change in wind speed with height
- Change in wind direction with height
- Change in both speed and direction with height



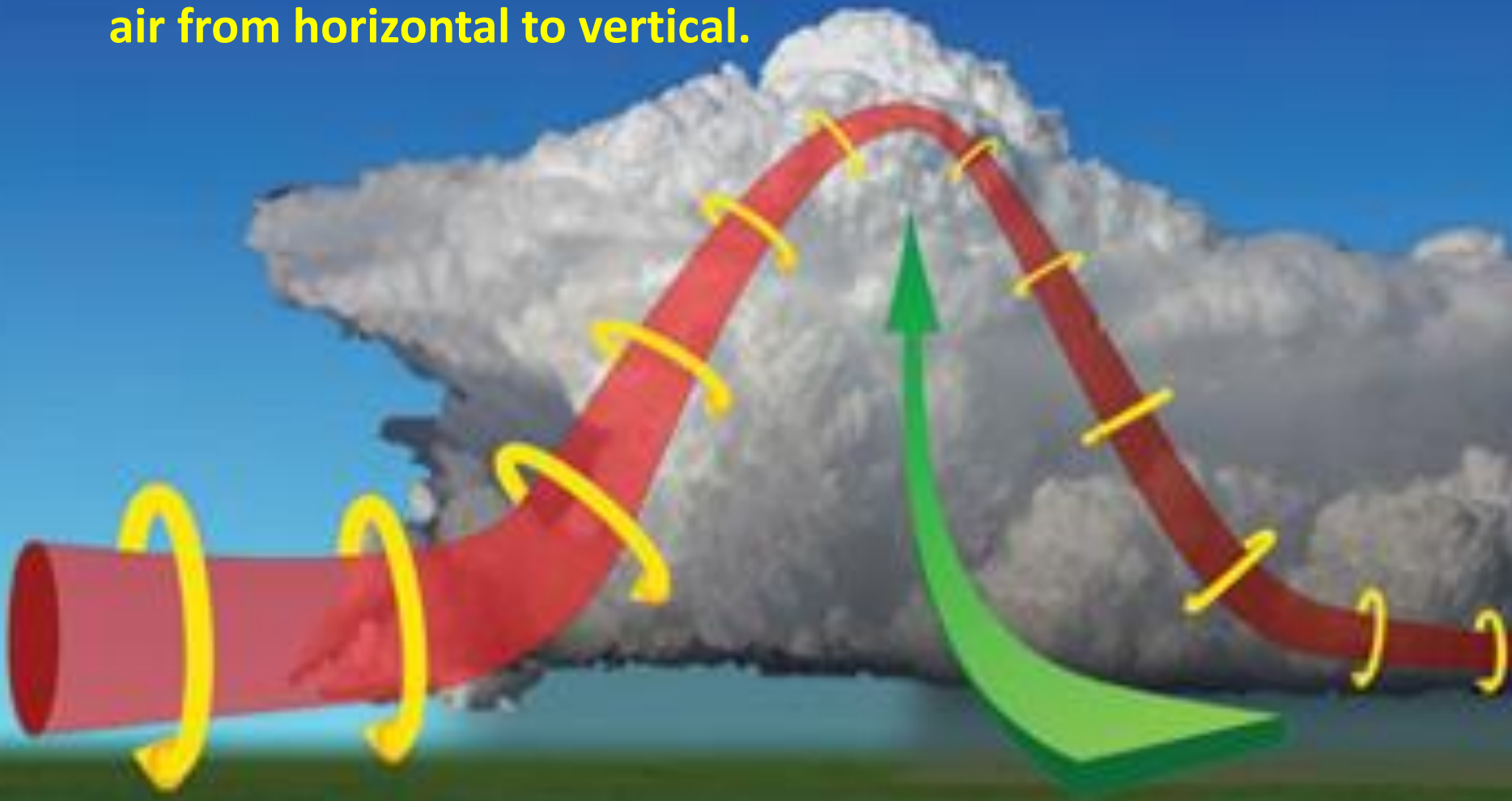
# Wind Shear

**Winds change direction and increase in speed with altitude. This creates an invisible, horizontal spinning effect in the lower atmosphere.**



# Wind Shear and Updraft

Rising air within the thunderstorm updraft tilts the rotating air from horizontal to vertical.



# Mesocyclone Formation

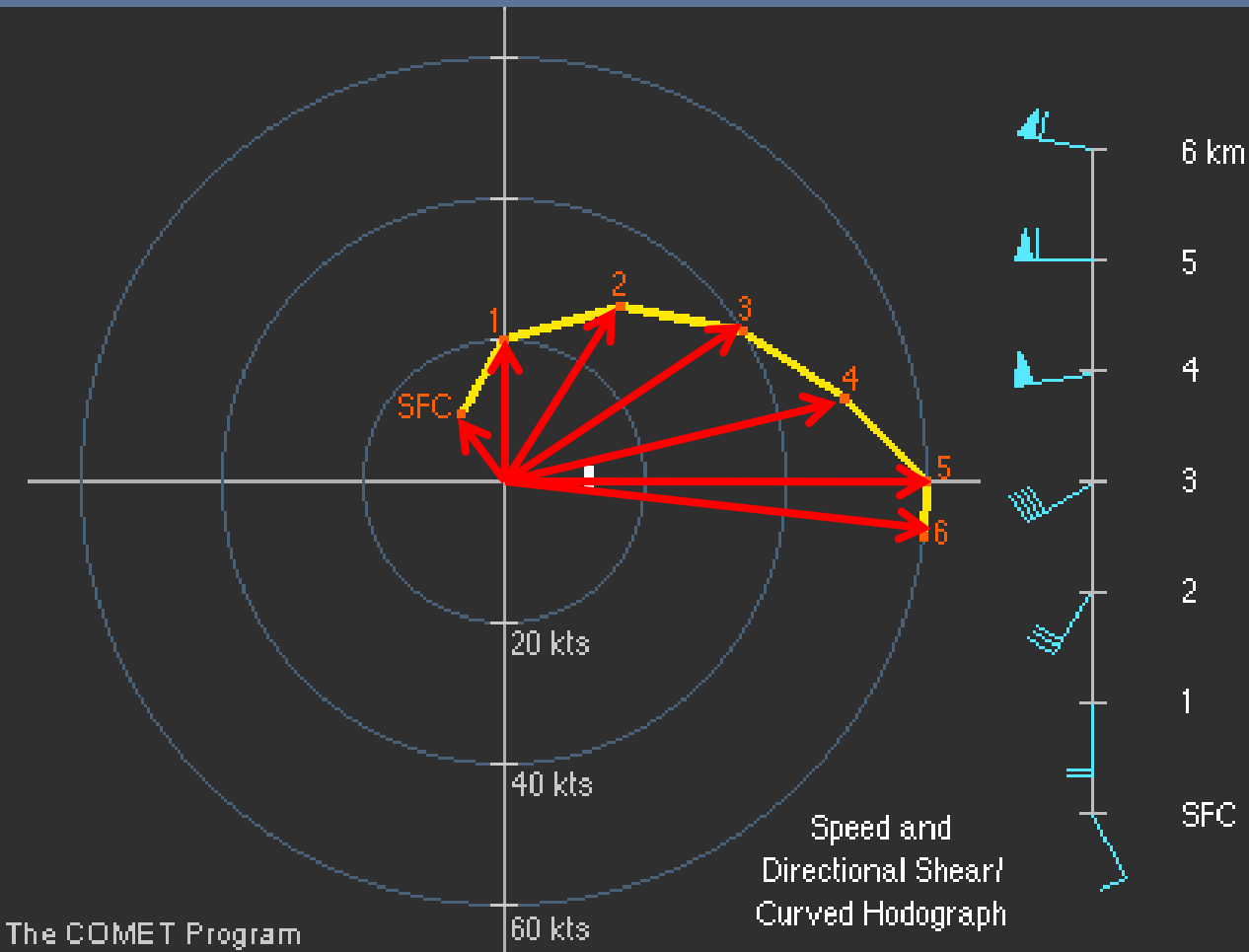
A mesocyclone, an area of rotation 2-6 miles wide, now extends through much of the storm. Most tornadoes form within this area of strong rotation.





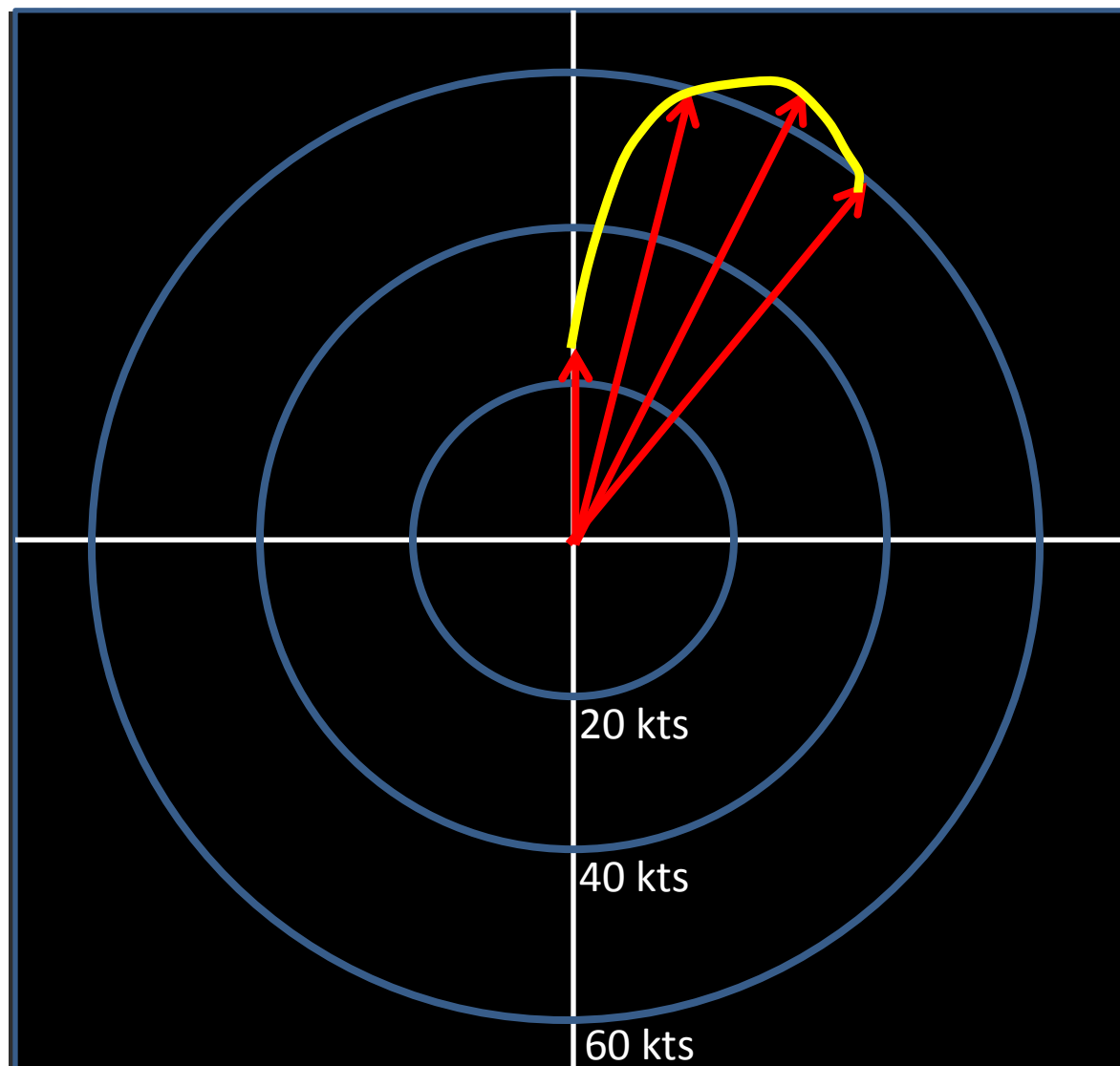
# The 3-Dimensional Atmosphere

## Wind Shear



- Wind speed is typically calculated in terms of speed and direction. The change in these is known as **Helicity** or **Storm Relative Helicity**.
- Helicity is measured at several height levels, and that determines what type of storm is likely to form or what the **mode of convection** will be.
- 0 to 6 kilometers (storm motions)
- 0 to 3 km (supercells, multicell, or ordinary cell?)
- 0 to 1 km (tornadoes?)

## 72230 BMX Shelby County Airport



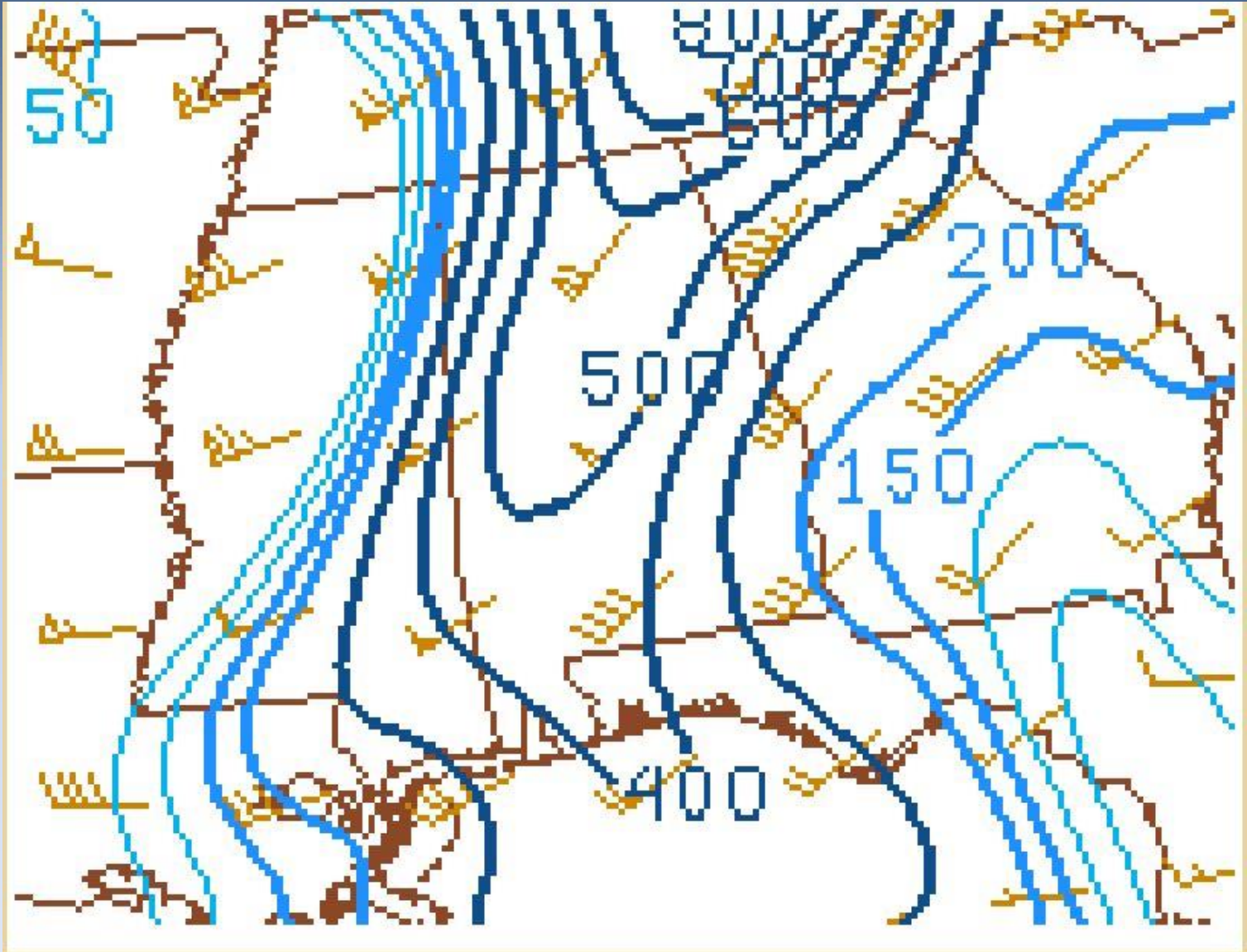
SLAT 33.16  
 SLON -86.76  
 SELV 178.0  
 SHOW -6.26  
 LIFT -8.05  
 LFTV -8.78  
 SWET 601.9  
 KINX 32.70  
 CTOT 26.90  
 VTOT 28.50  
 TOTL 55.40  
 CAPE 2944.  
 CAPV 3172.  
 CINS -6.19  
 CINV -5.23  
 EQLV 143.0  
 EQTV 142.9  
 LFCT 890.2  
 LFCV 891.4  
 BRCH 14.24  
 BRCV 15.35  
 LCLT 293.7  
 LCLP 917.5  
 MLTH 301.0  
 MLMR 16.98  
 THCK 5738.  
 PWAT 41.83

00Z 28 Apr 2011

University of Wyoming

# The 3-Dimensional Atmosphere

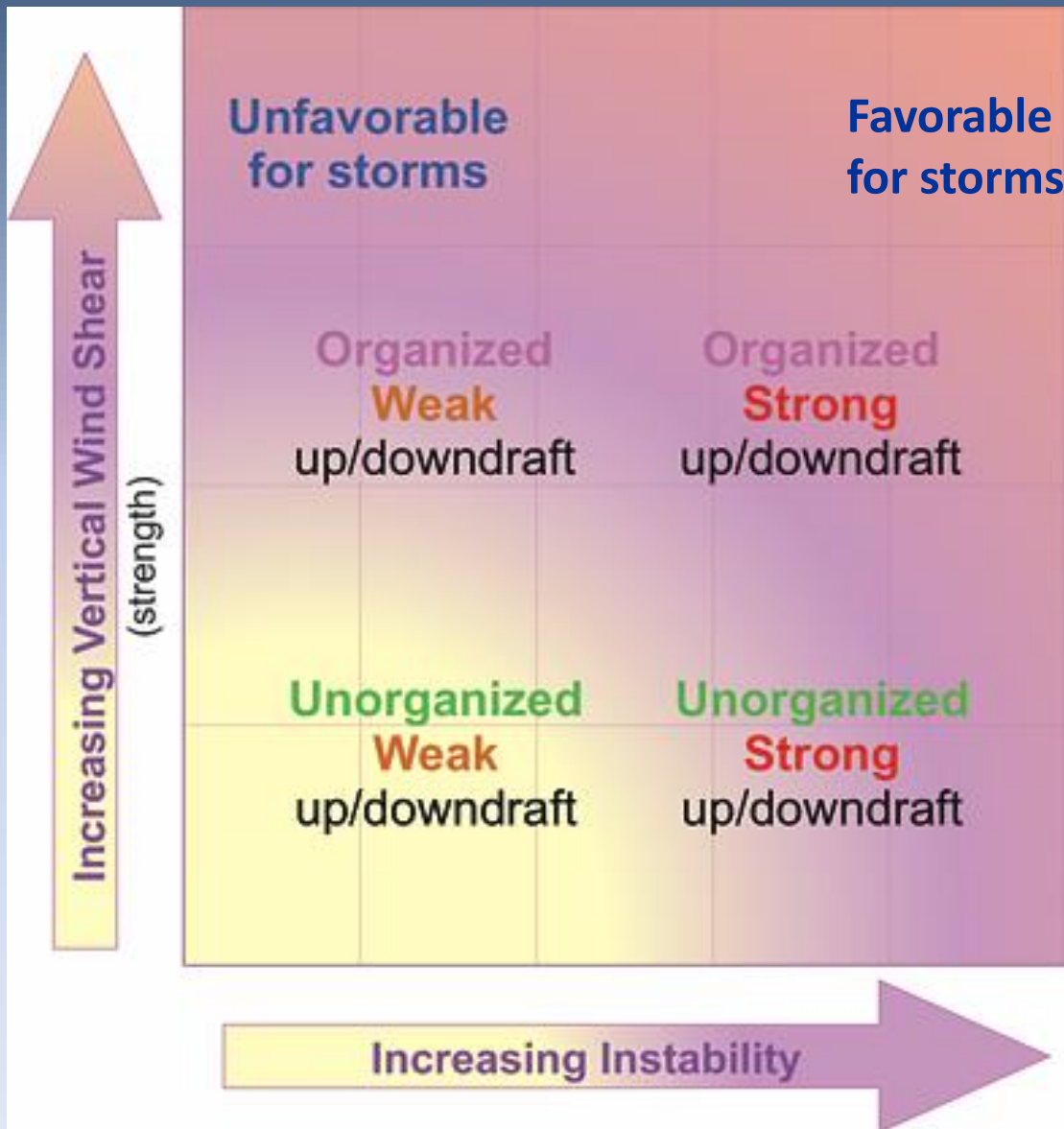
## Wind Shear





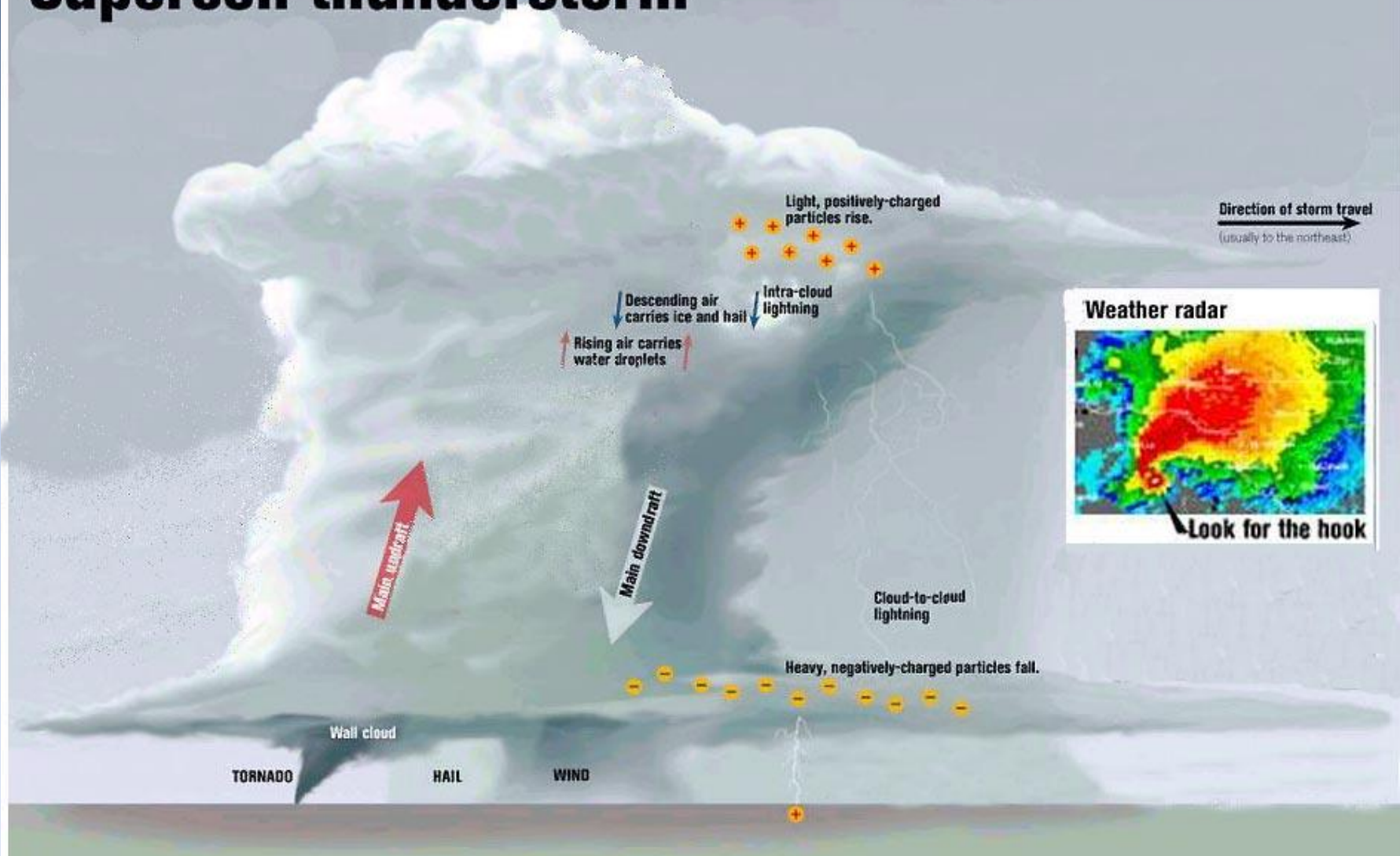
# Finding the Perfect Balance

## Instability versus Wind Shear



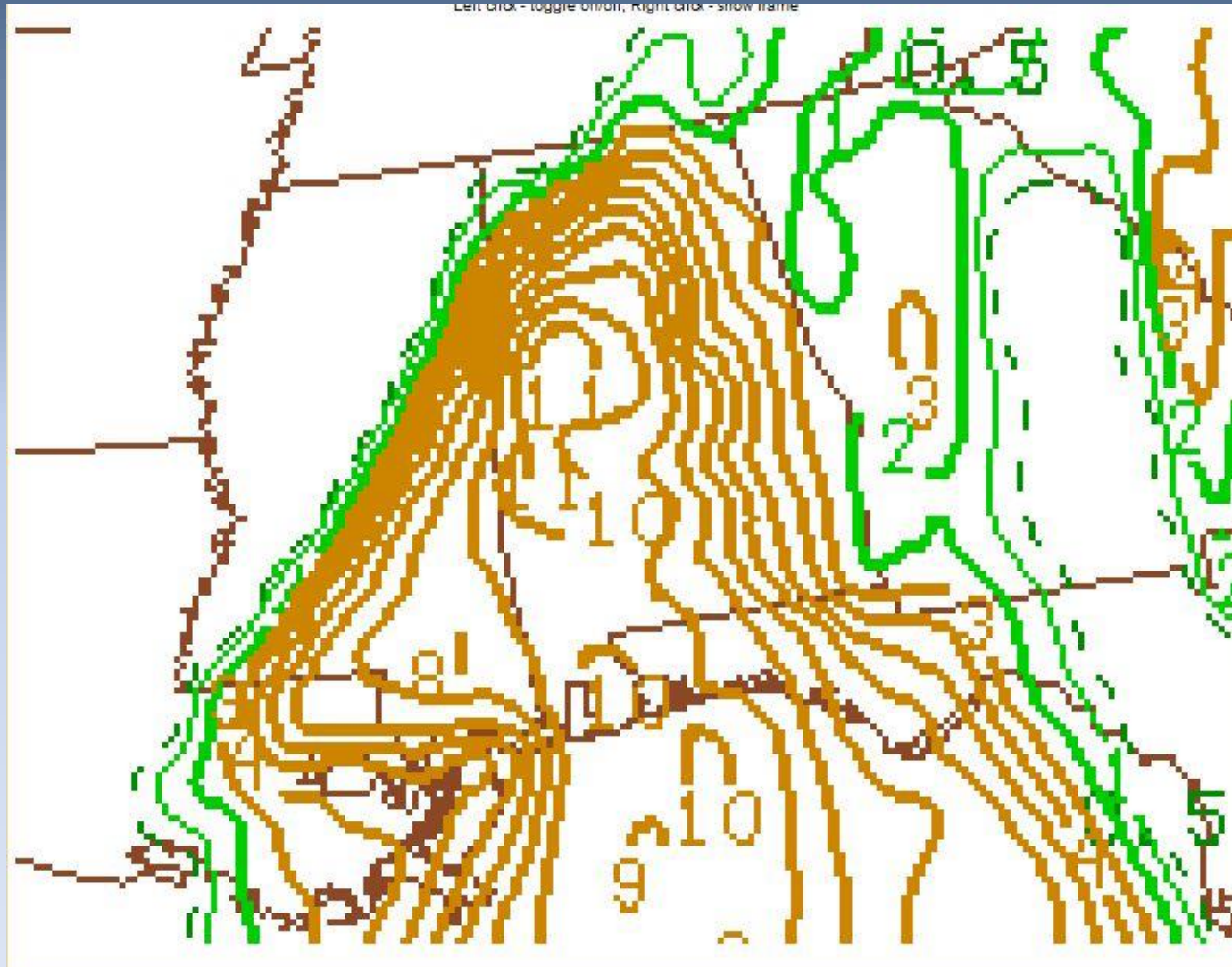
- Finding the perfect balance between instability and wind shear remains a forecast challenge.
- All about the favorable **mode of convection**.

# Supercell thunderstorm



# Finding the Perfect Balance

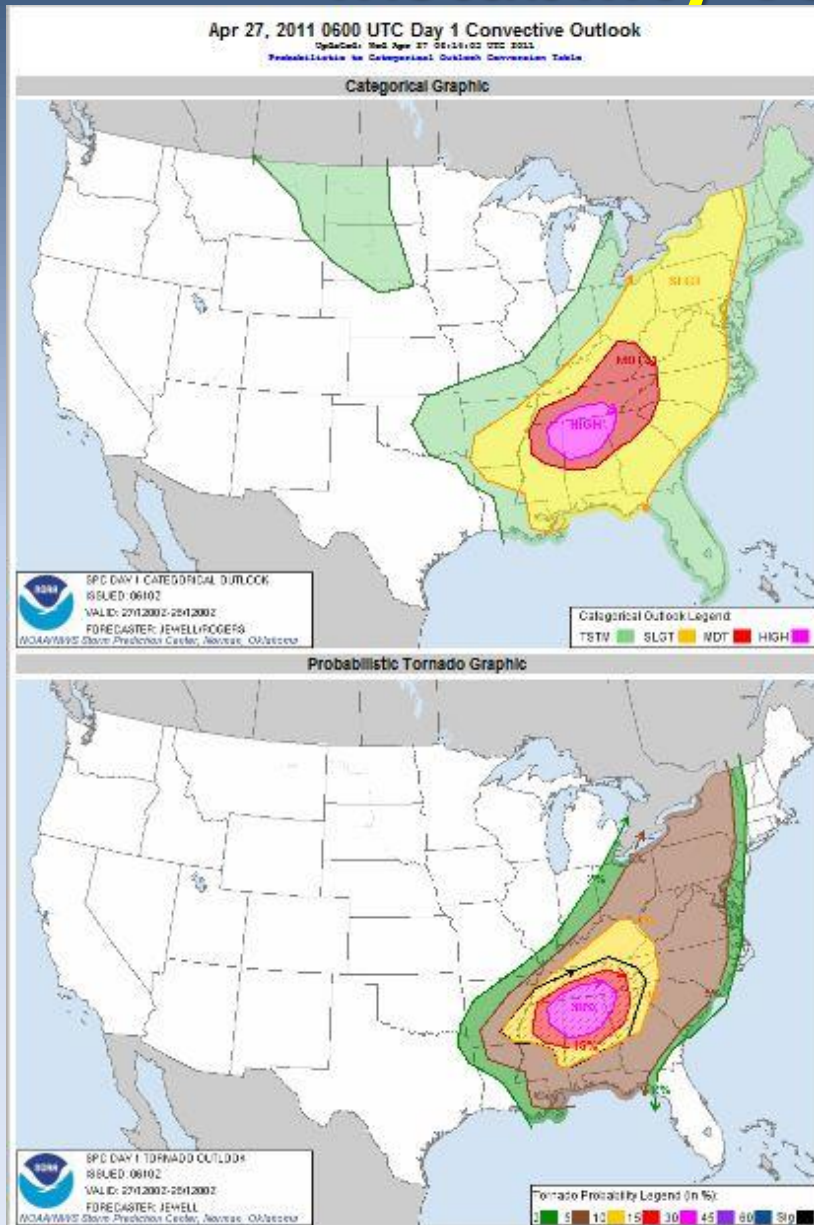
## Instability versus Wind Shear



- Certain products like the **Energy Helicity Index** (EHI) can help you determine the mode of convection.
- $EHI > 4$  Watch Out!
- $EHI 1 - 3$  marginal
- $EHI < 1$  low



# Finding the Perfect Balance Instability versus Wind Shear

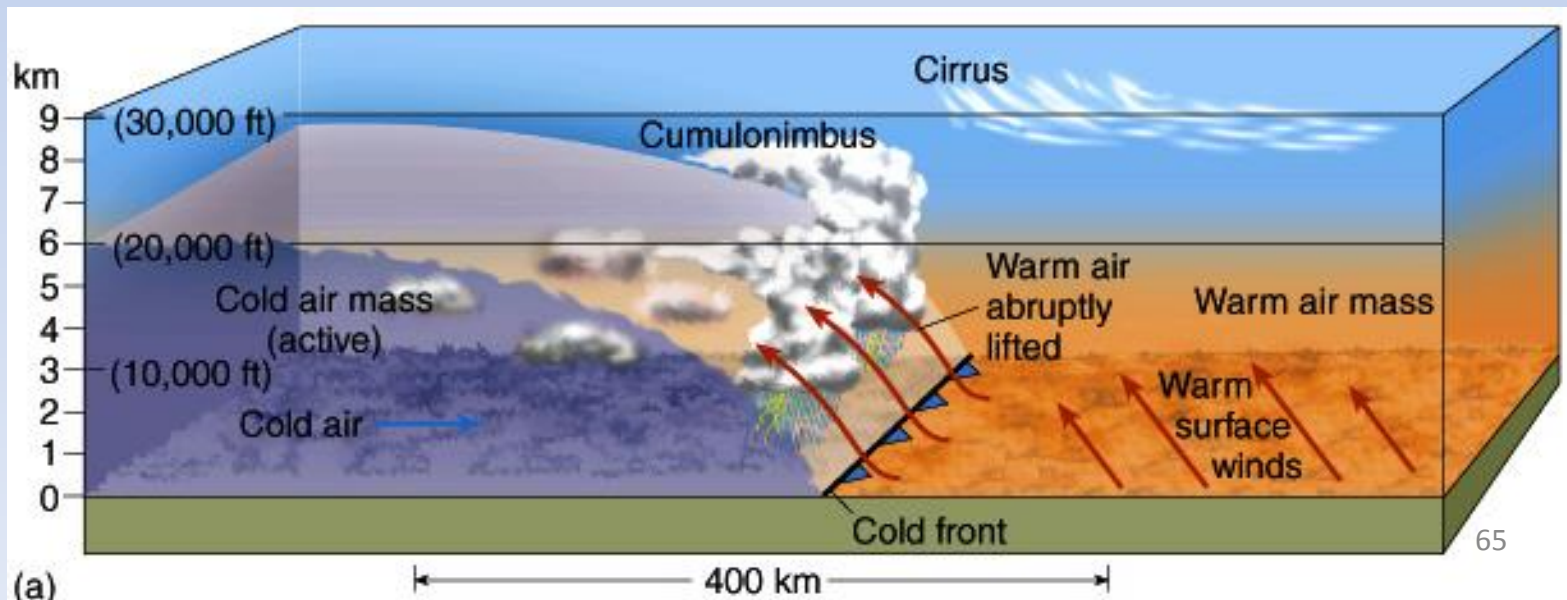
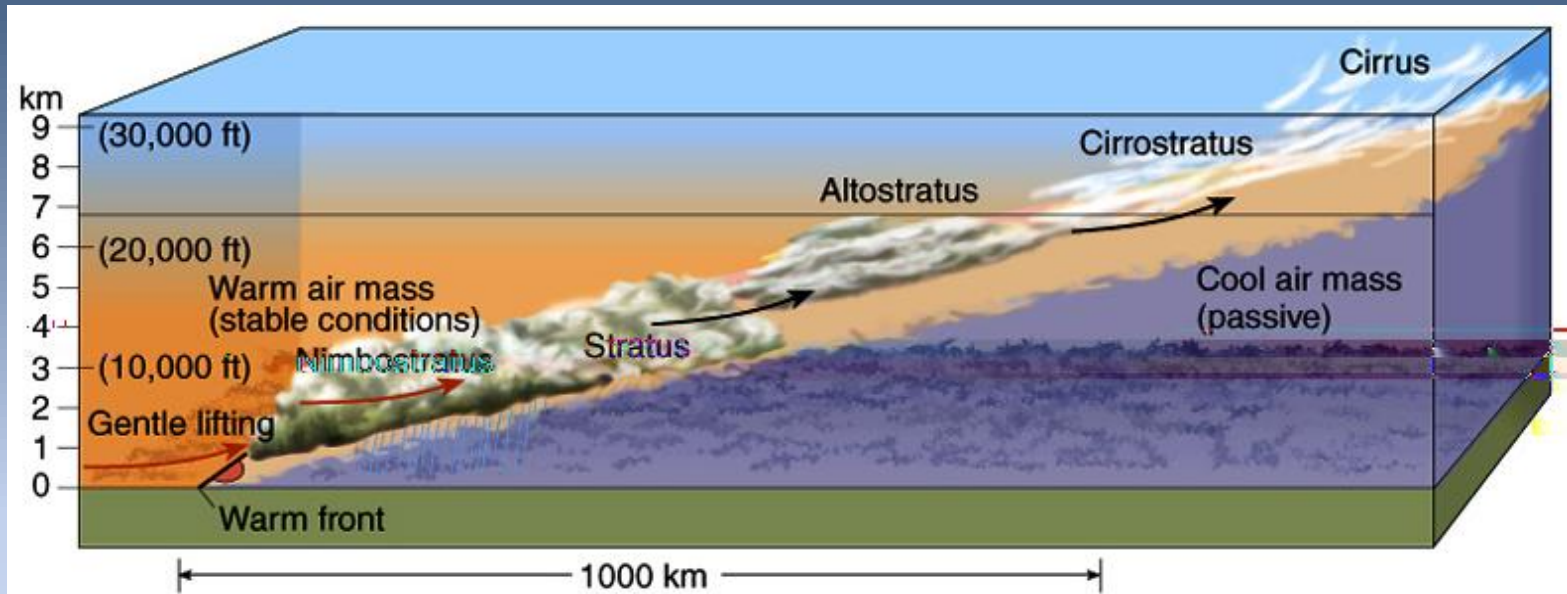


DAY 1 CONVECTIVE OUTLOOK NWS STORM  
PREDICTION CENTER NORMAN OK  
0755 AM CDT WED APR 27 2011

...MS/AL/TN/KY/GA AREA THROUGH TONIGHT... A RESERVOIR OF 70-72 F BOUNDARY LAYER DEWPOINTS FROM SRN LA TO SRN AL WILL SPREAD NWD IN THE WAKE OF THE MORNING STORMS...BENEATH THE REMNANTS OF STEEP MIDLEVEL LAPSE RATE PLUME SPREADING EWD FROM TX/LA. SURFACE HEATING WITHIN THE MOIST WARM SECTOR WILL BOOST **MLCAPE VALUES TO 2500-4000 J/KG** ALONG AND S OF THE REMNANT OUTFLOW BOUNDARY...AND REDUCE CONVECTIVE INHIBITION BY ABOUT MIDDAY. THIS WILL ALLOW THE DEVELOPMENT OF SCATTERED-NUMEROUS WARM SECTOR SUPERCELLS ALONG CONFLUENCE BANDS E OF THE COLD FRONT/DRYLINE BY EARLY AFTERNOON. THE VERTICAL SHEAR ENVIRONMENT WILL BECOME VERY FAVORABLE FOR TORNADIC SUPERCELLS...CHARACTERIZED BY **LONG/CURVED HODOGRAPHS WITH EFFECTIVE BULK SHEAR IN EXCESS OF 70 KT AND EFFECTIVE SRH OF 300-600 M2/S2** IN THE UNSTABLE WARM SECTOR.

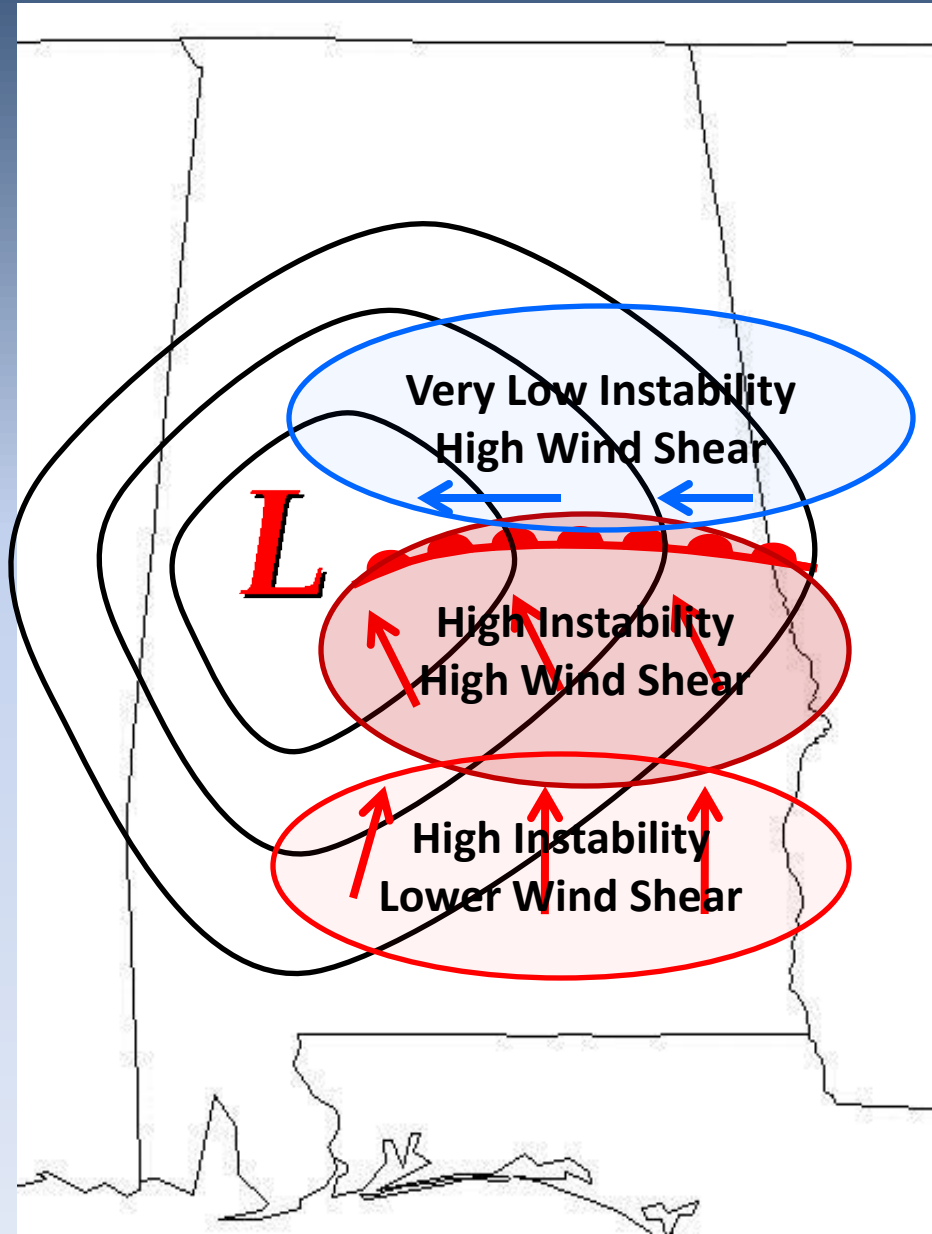
# The 3-Dimensional Atmosphere

## Location of that Perfect Balance



# The 3-Dimensional Atmosphere

## Warm Front

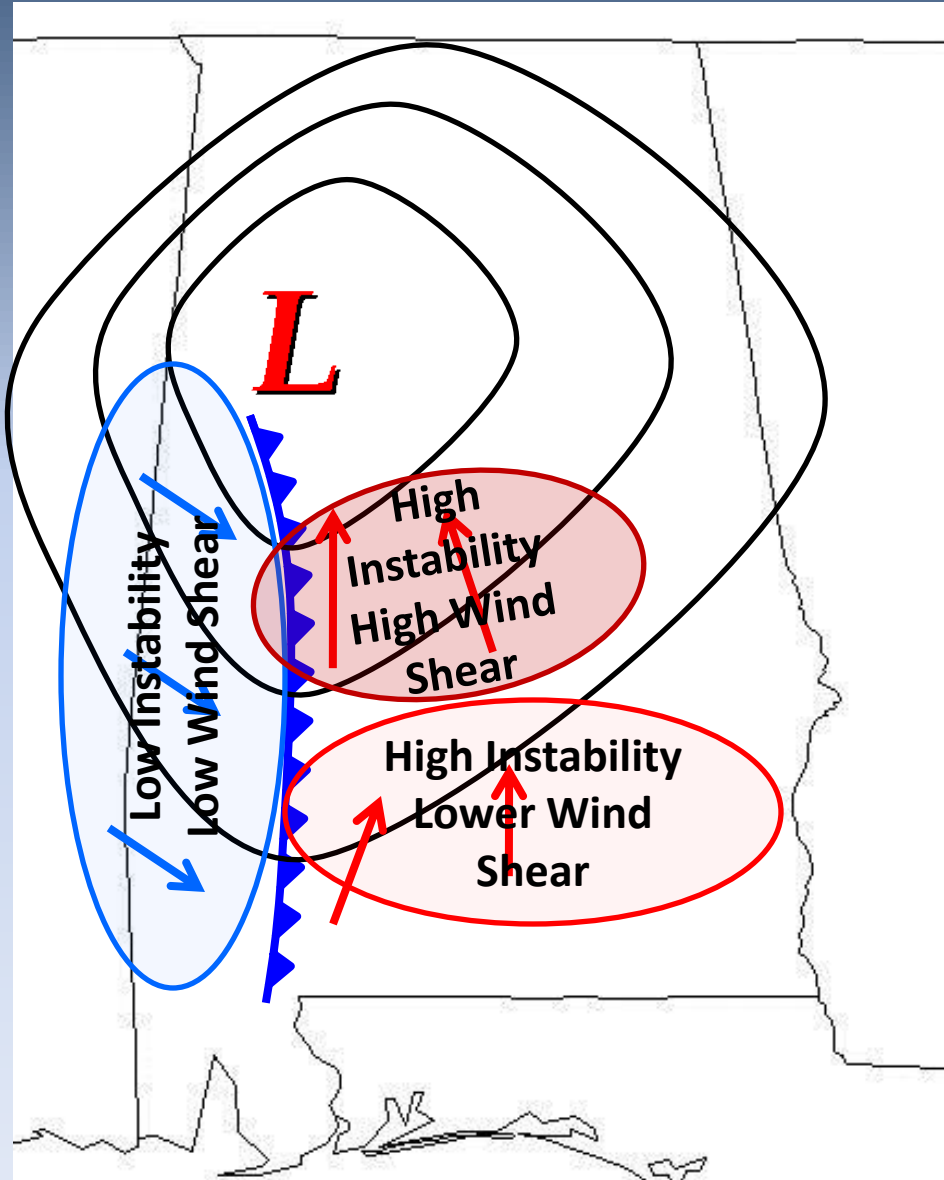


- Warm fronts are typically characterized by a distinct wind-shift from the south to the east as you go from south to north.
- South of the warm front the airmass is unstable with high wind shear.
- North of the warm front the wind shear can remain high, but the instability decreases significantly.



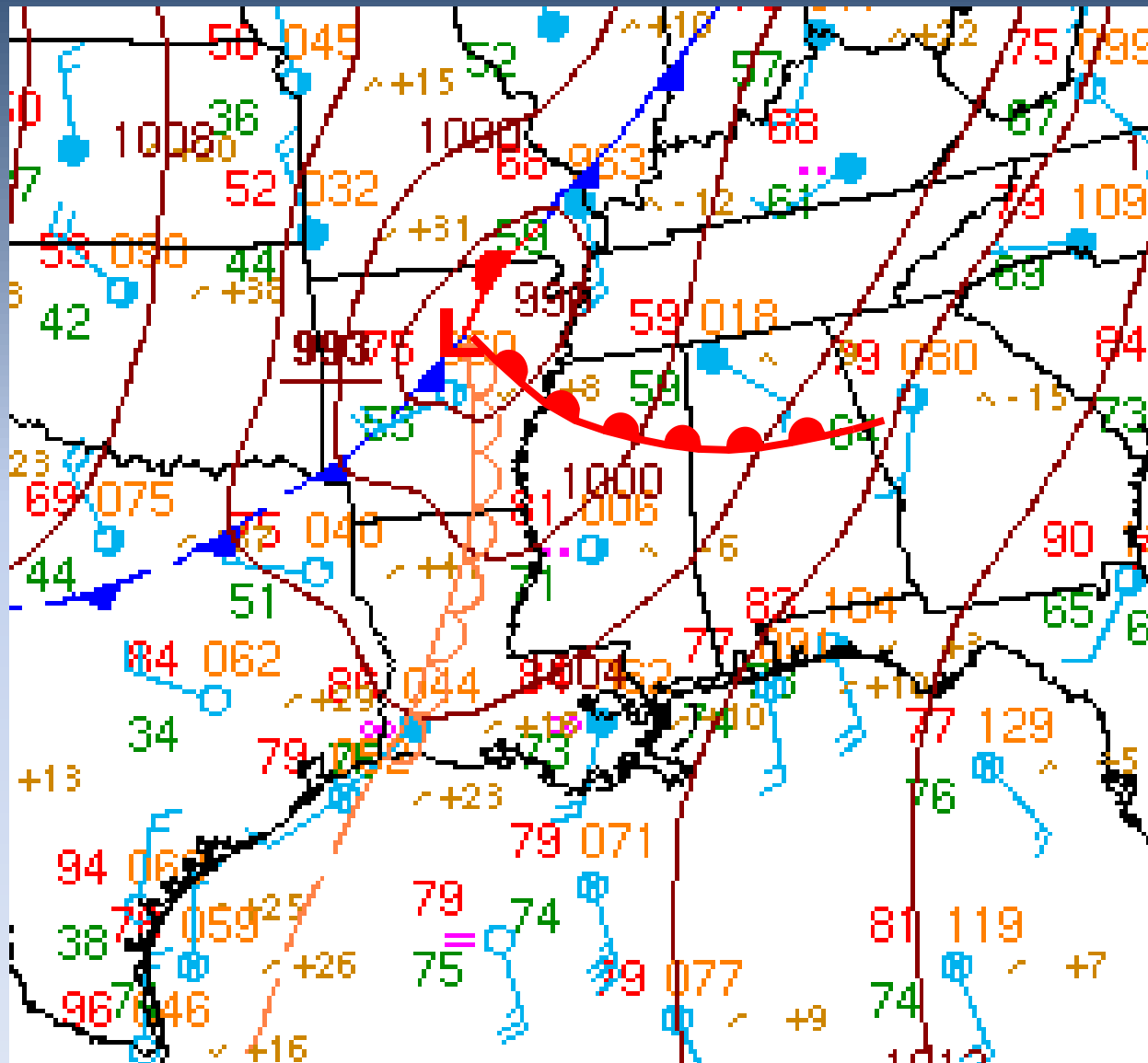
# The 3-Dimensional Atmosphere

## Cold Front

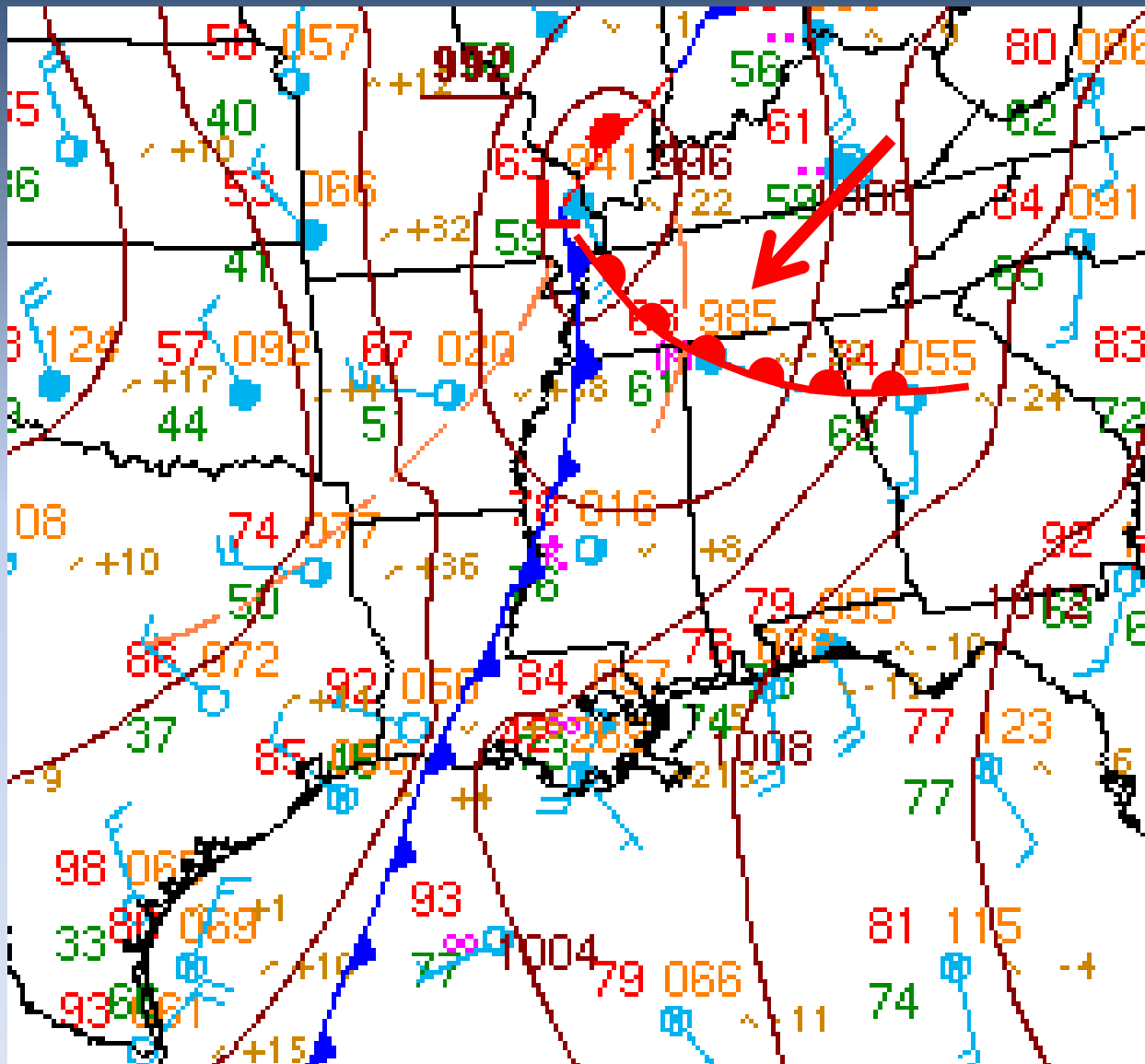


- Cold Fronts are characterized by an abrupt wind-shift from the south to the northwest as you go from east to west.
- Ahead of the cold front, generally there is unstable air with high wind shear.
- Behind the cold front the air is colder, drier and virtually no instability or wind shear.

# 1 pm Sfc Analysis

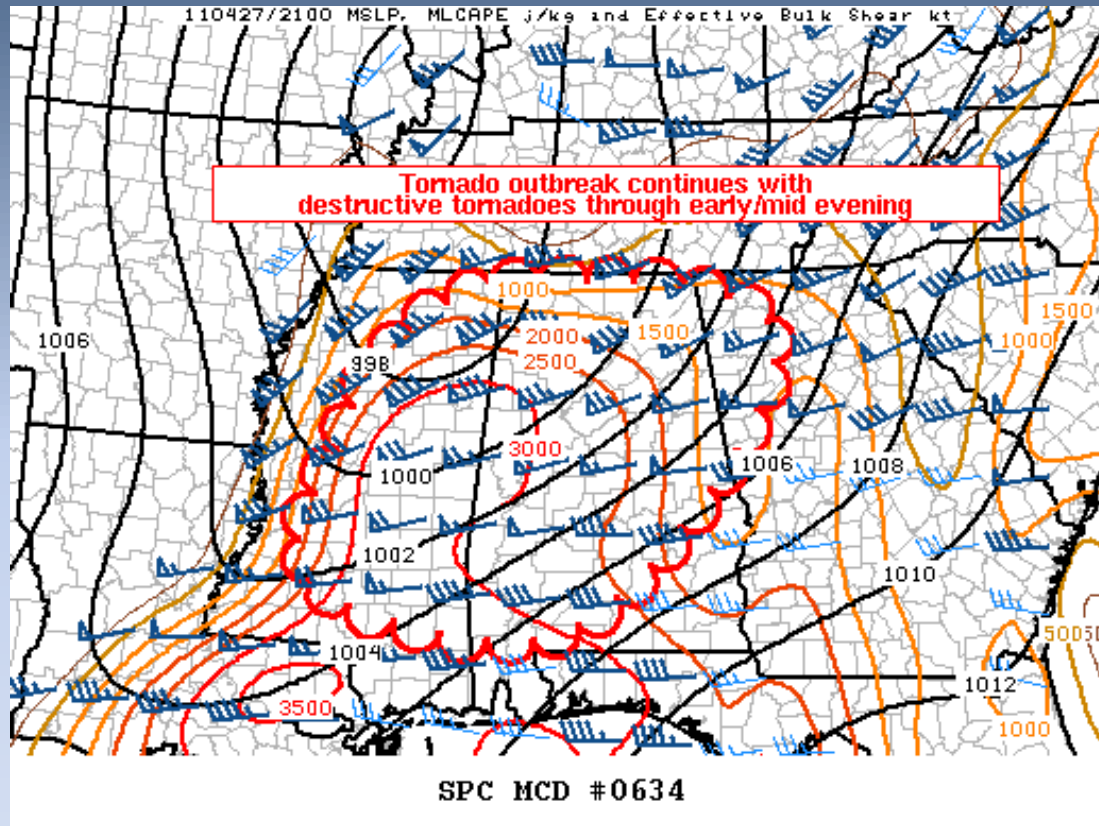


# 4 pm Sfc Analysis





MESOSCALE DISCUSSIONS  
NWS STORM PREDICTION CENTER  
WEDNESDAY APRIL 27, 2011

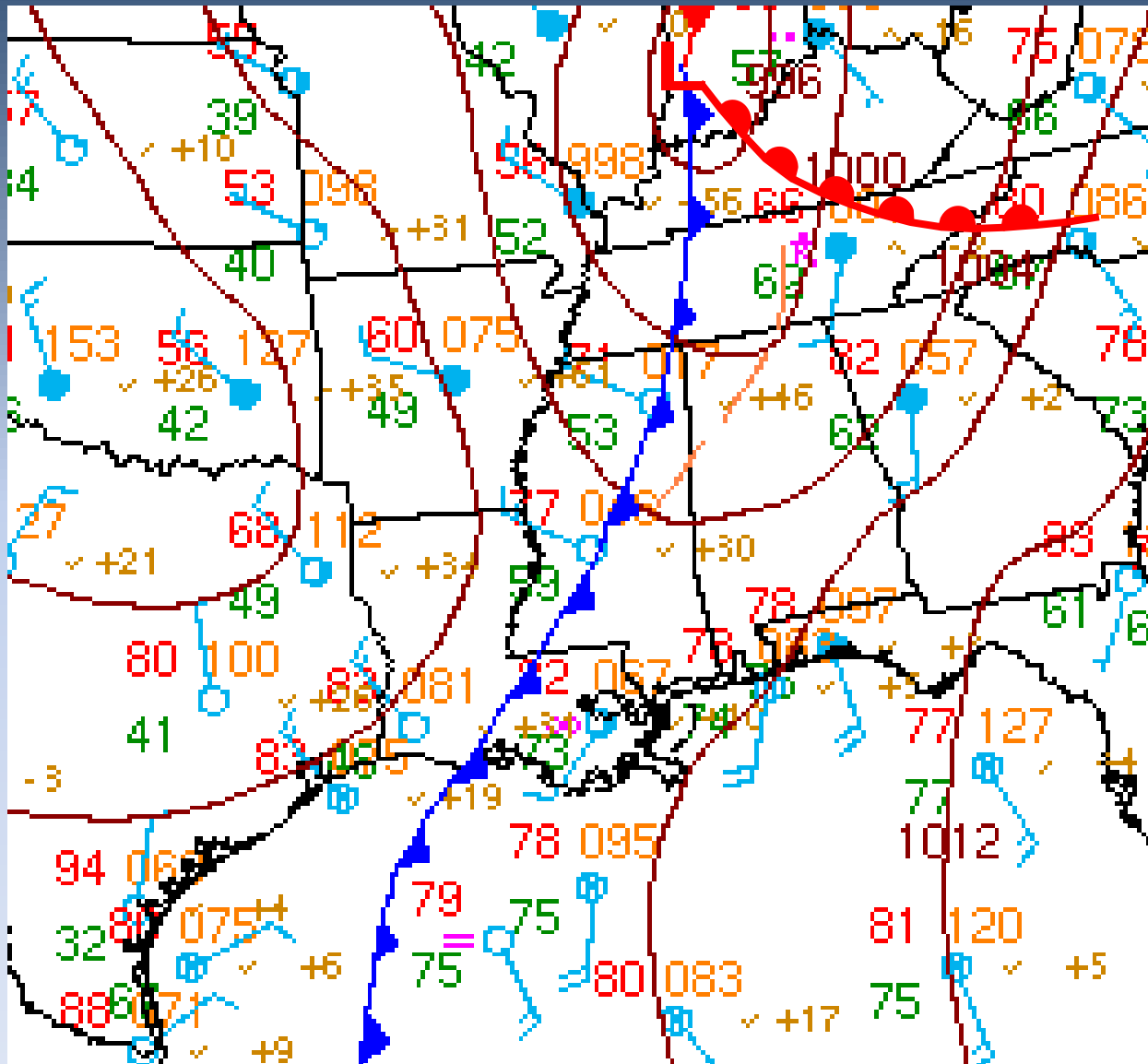


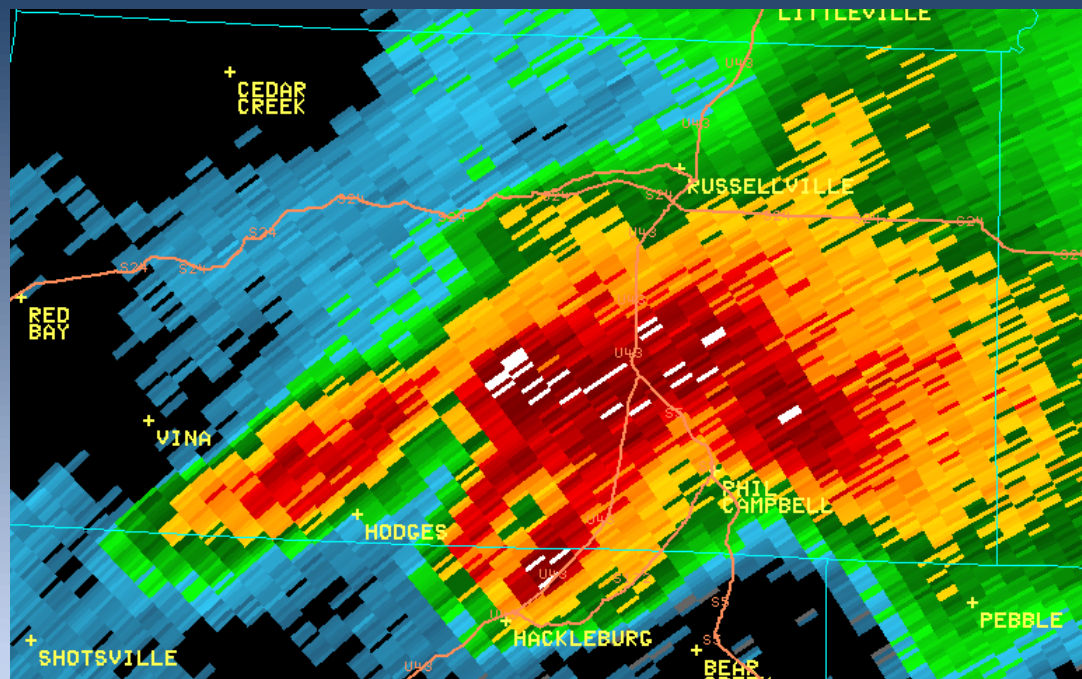
“MLCAPE VALUES ARE  
AS HIGH AS  
2000-4000 J/KG  
WITHIN THE WEAKLY  
CAPPED WARM SECTOR”

“WSR-88D VWP DATA  
NOW REFLECTS 0-1 KM  
SRH IN EXCESS OF  
600 M2/S2”

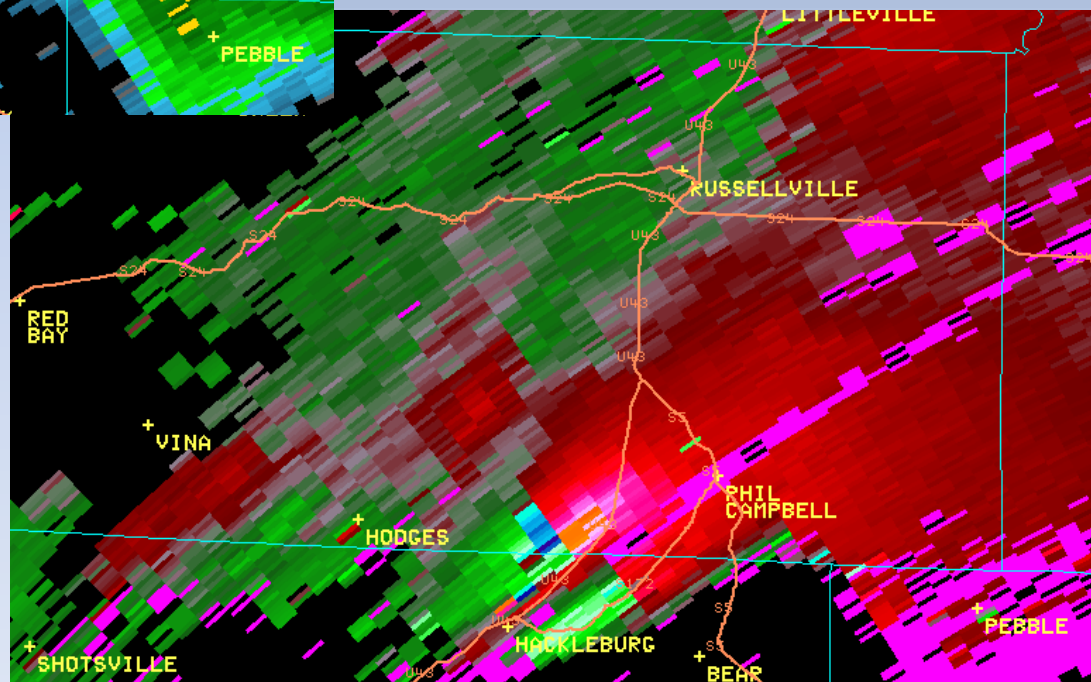
“A LONG CURVING HODOGRAPH  
WITHIN THE LOWEST 1-2 KM”

# 7 pm Sfc Analysis

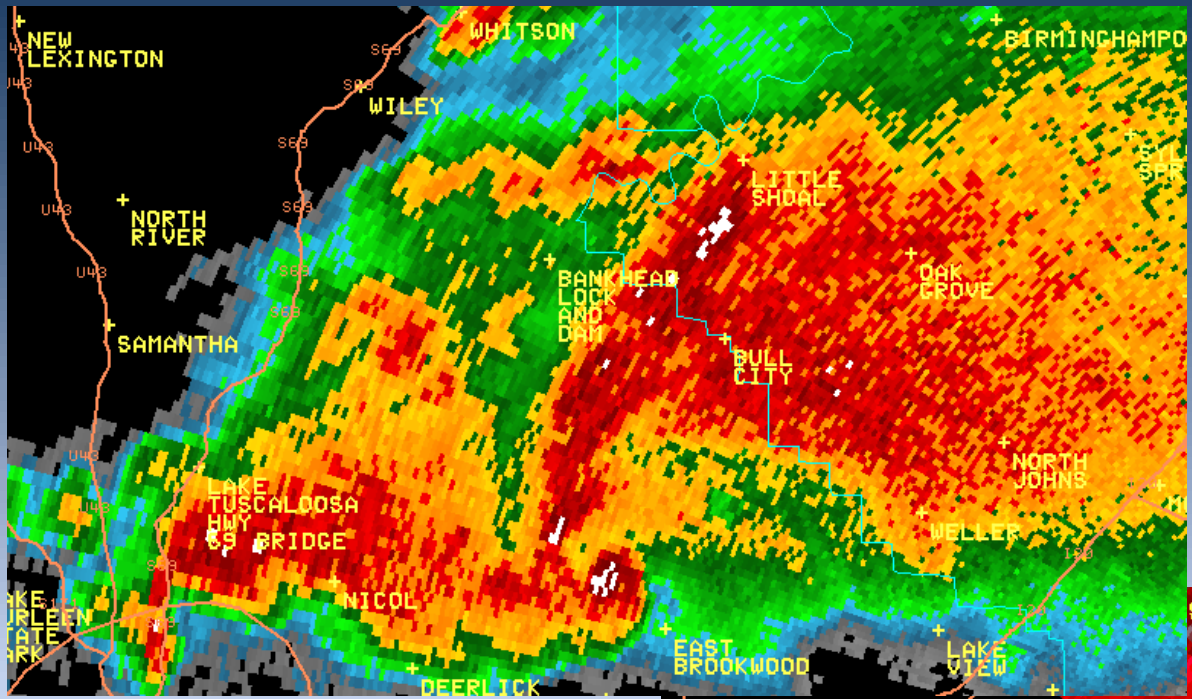




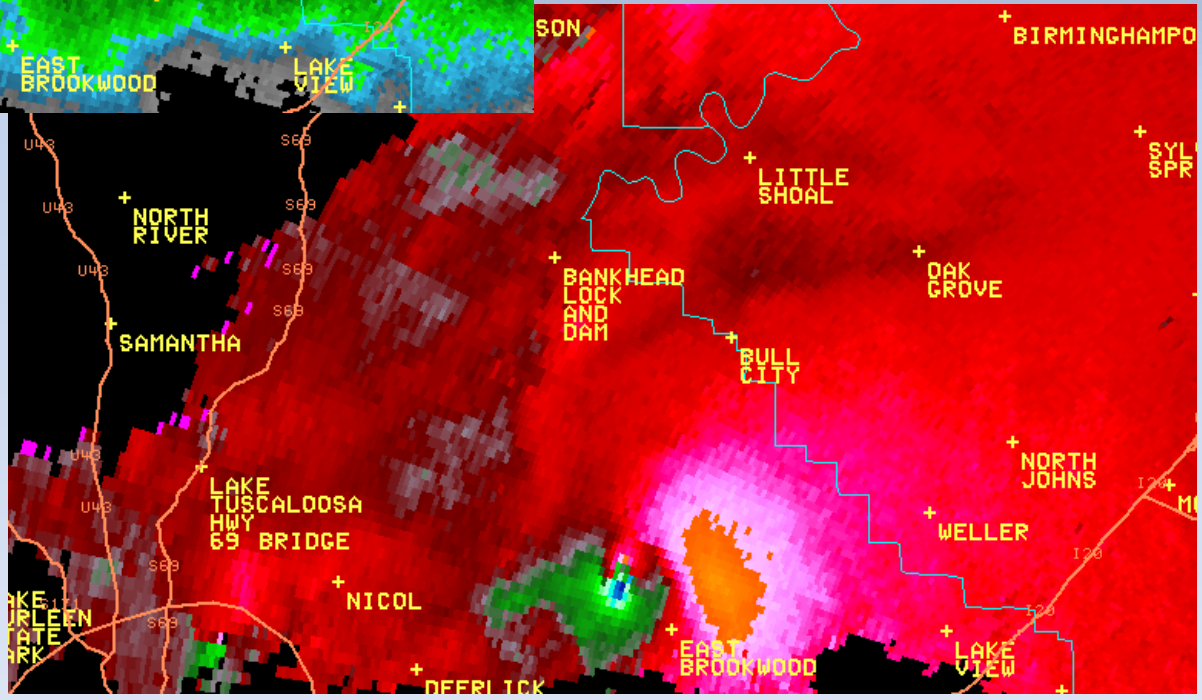
## Between Hackleburg And Phil Campbell

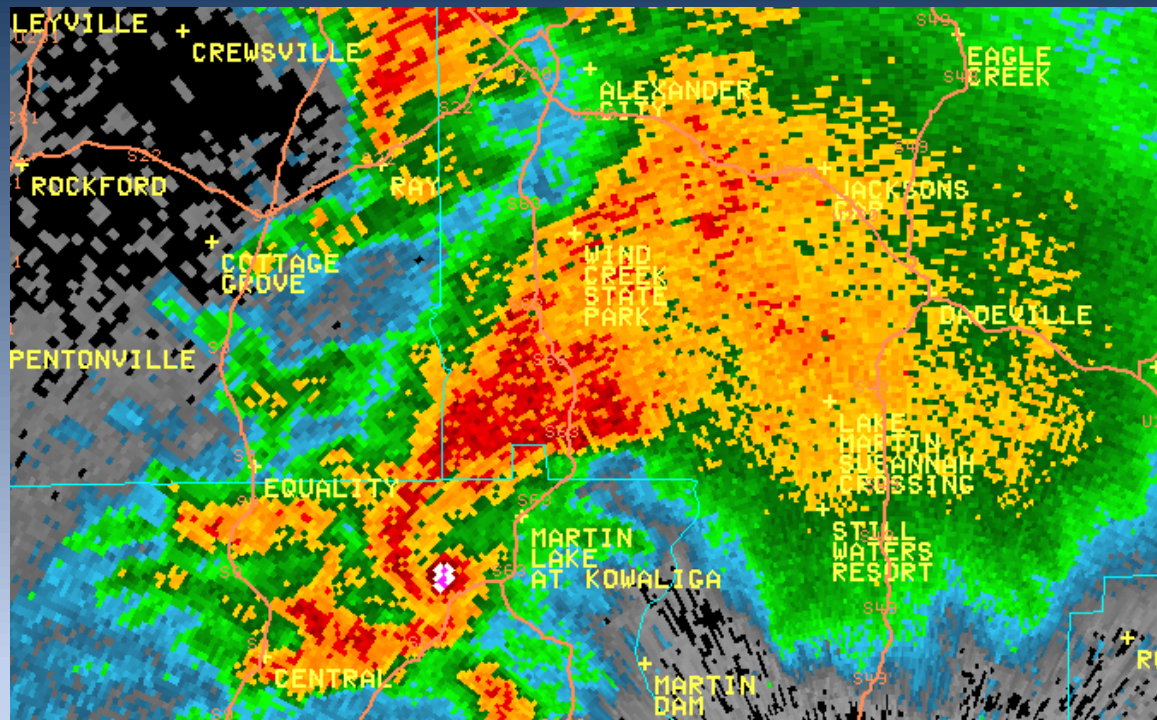




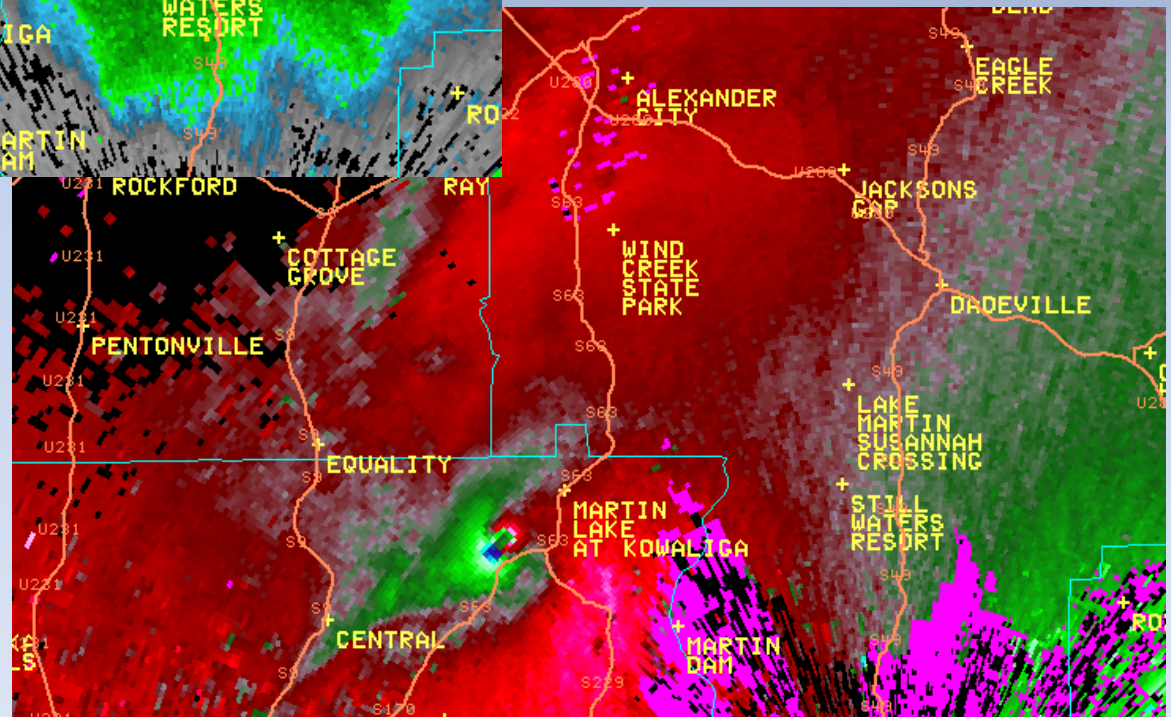


**Between Tuscaloosa  
and Birmingham**





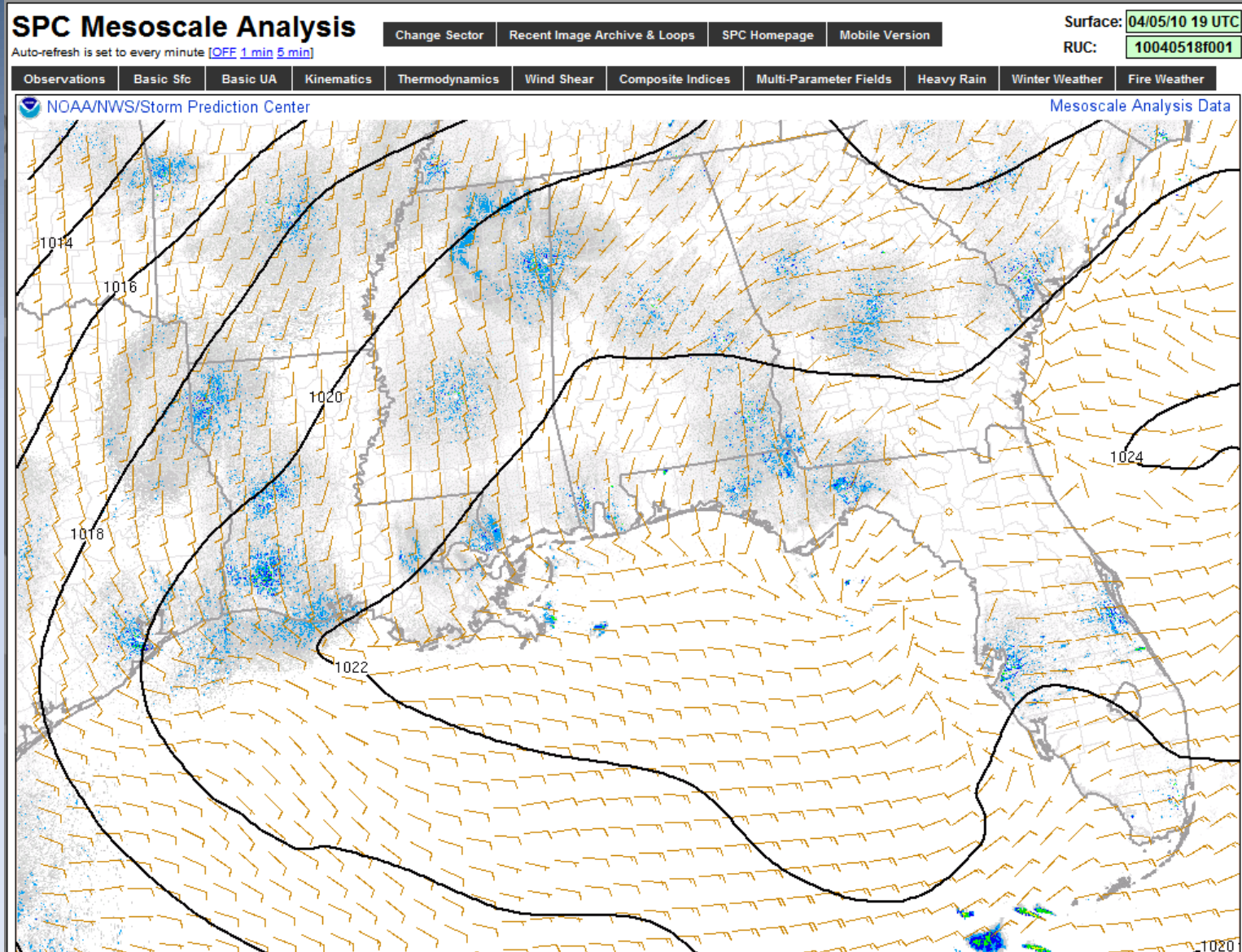
## Entering Lake Martin





# Instability, Wind Shear, and Lifting Mechanisms

## Where Can I Get Help?





Region	Type of plot	Year	Month	From	To
th America	Text: List	2009	Nov	29/12Z	29/12Z

Click on the image to request a sounding at that location or enter the station number below.



Station Number: 72249

☐ Recalculate Data

72249 Ft Worth, TX (FWD)

# 72230 BMX Shelby County Airport

100

200

300

400

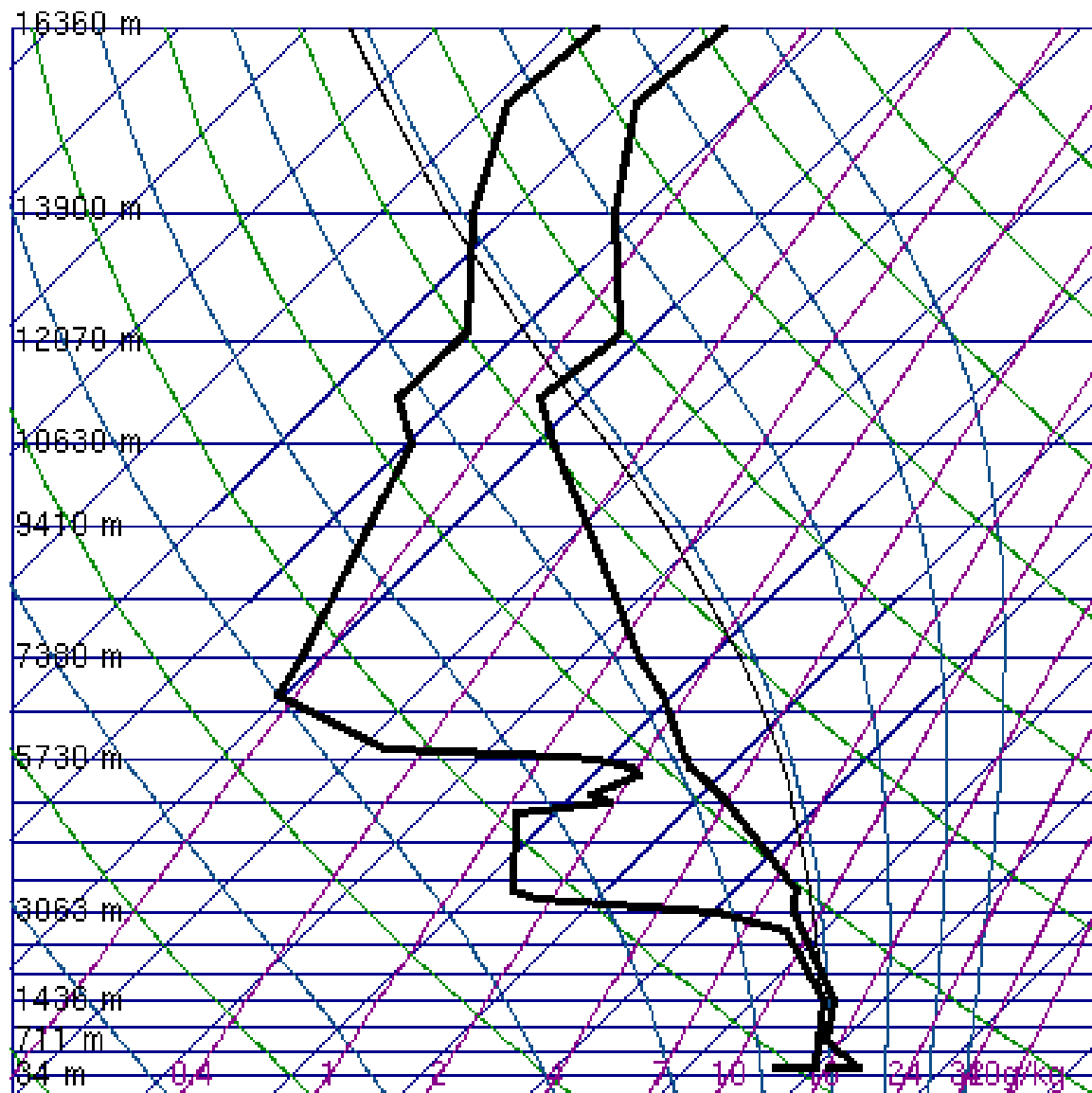
500

600

700

800

900



LIFT -7.38

KINX 39.90

TOTL 59.80

CAPE 1829.



# Instability, Wind Shear, and Lifting Mechanisms

## Where Can I Get Help?

<http://www.spc.noaa.gov/exper/mesoanalysis/>

<http://weather.uwyo.edu/upperair/sounding.html>

[http://www.srh.noaa.gov/bmx/?n=outreach\\_severeparameters](http://www.srh.noaa.gov/bmx/?n=outreach_severeparameters)

BREAK TIME



# What We Observe When Spotting Plains versus The Southeast

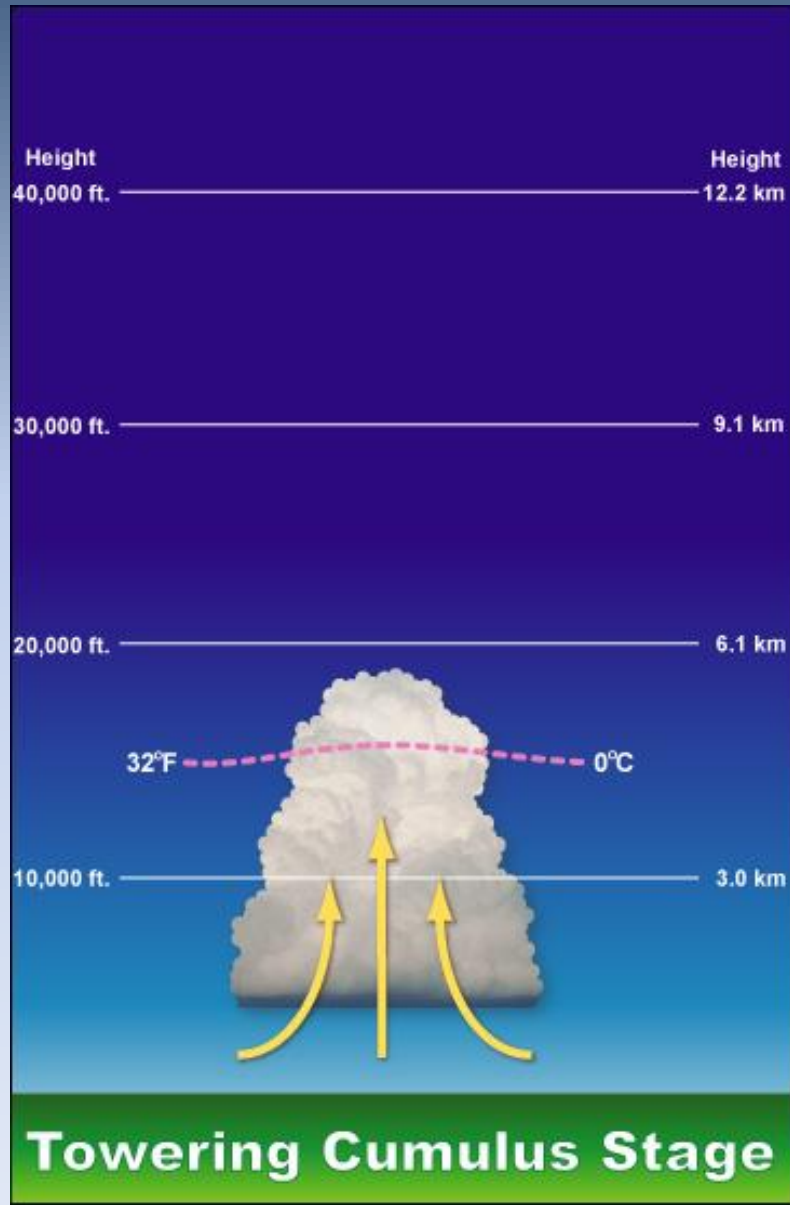




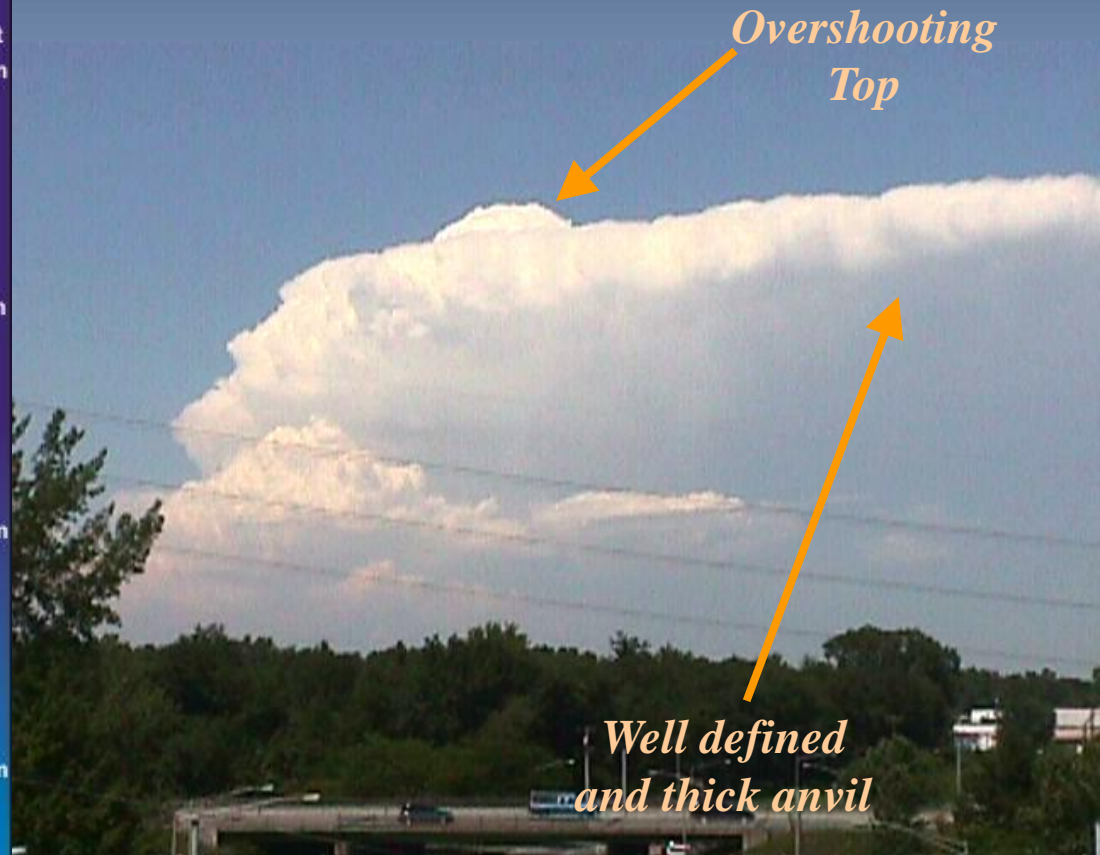
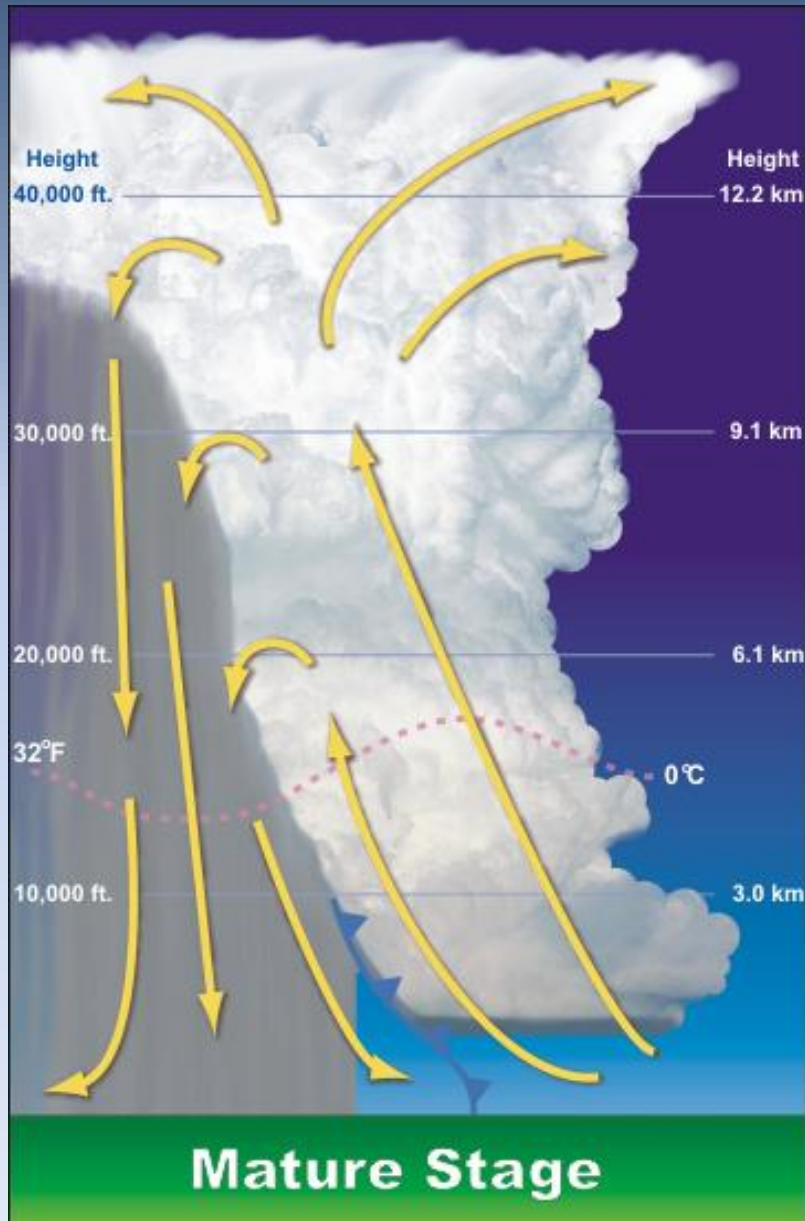




# What We Observe When Spotting Towering Cumulus



# What We Observe When Spotting Mature Stage



# Anvil Thickness/Texture



**If the anvil is thick, smooth-edged, and cumuliform (puffy, like the lower part of the storm), then the storm probably has a strong updraft and is a good candidate to produce severe weather.**



**If the anvil is thin, fuzzy, and glaciated (wispy, similar to cirrus clouds), then the updraft is probably not as strong, and the storm is less likely to produce severe weather.**



# A Updraft Tower Comparison

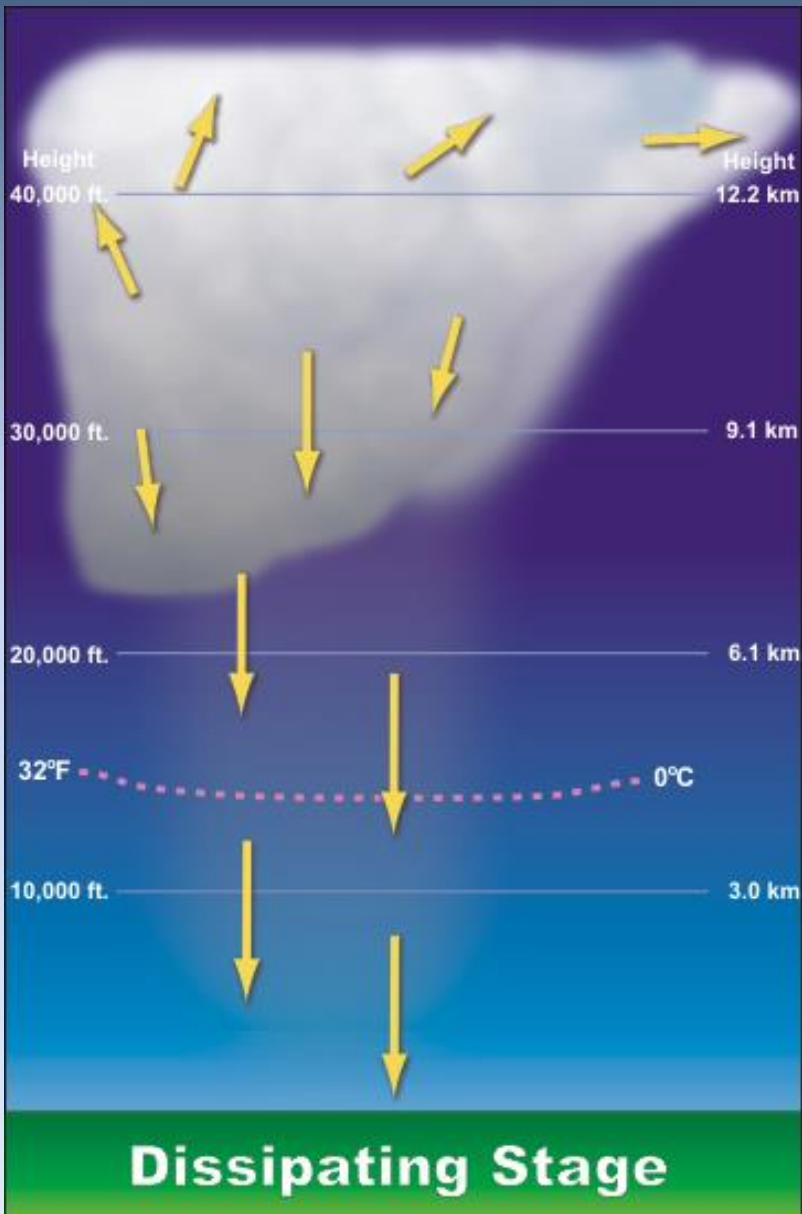


Strong Updraft  
(Probably high  
CAPE)



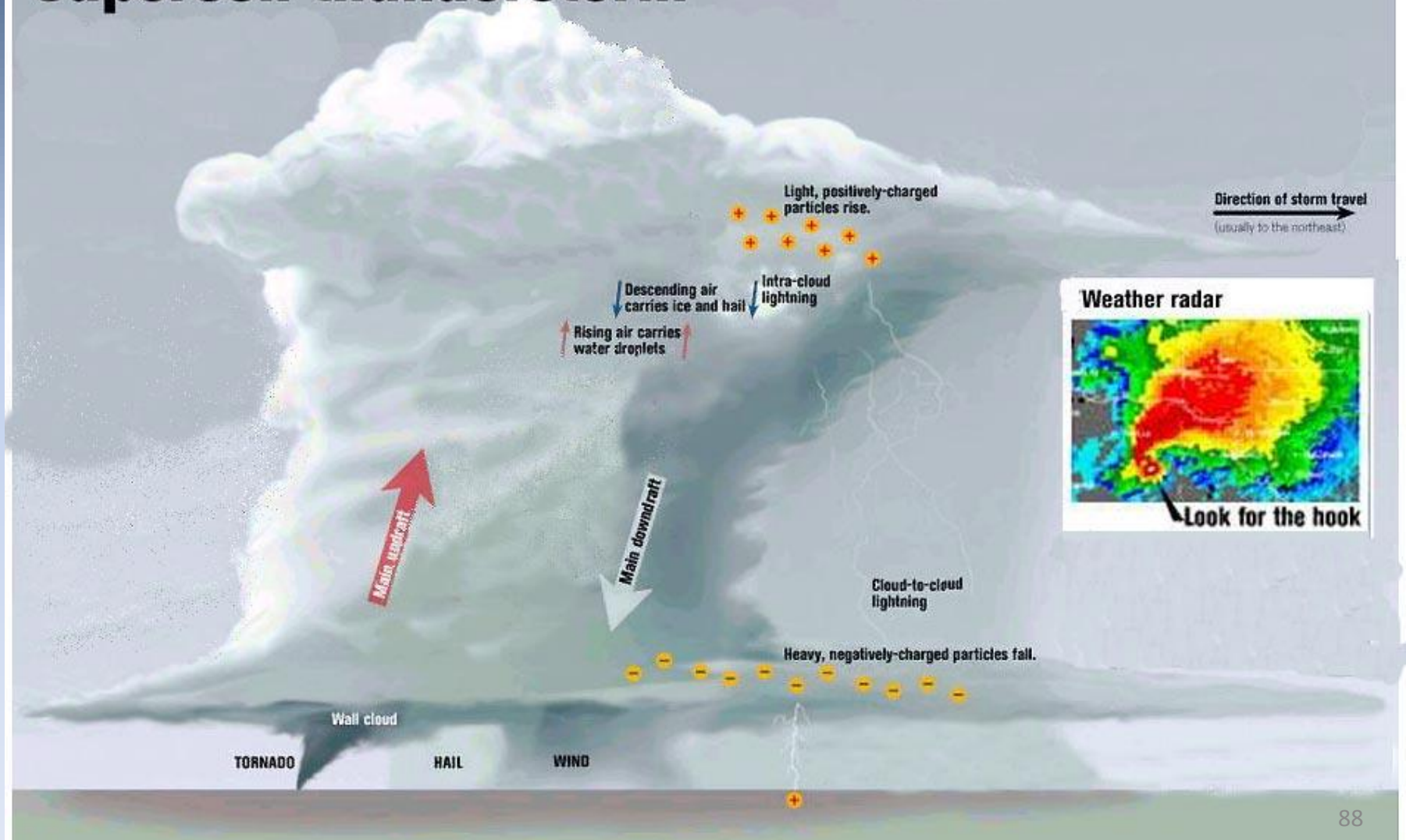
Weak Updraft  
(Probably low  
CAPE)

# What We Observe When Spotting Dissipation Stage



# What We Observe When Spotting Right Place - Right Time

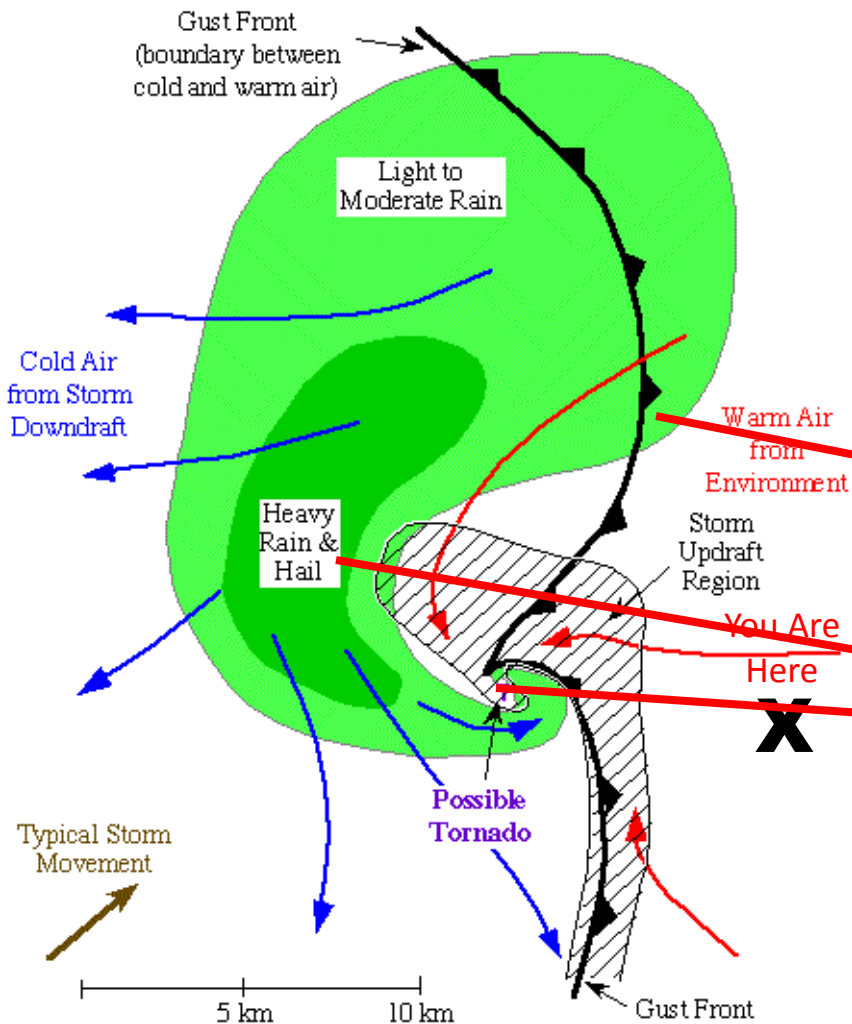
## Supercell thunderstorm





# What We Observe When Spotting SuperCell

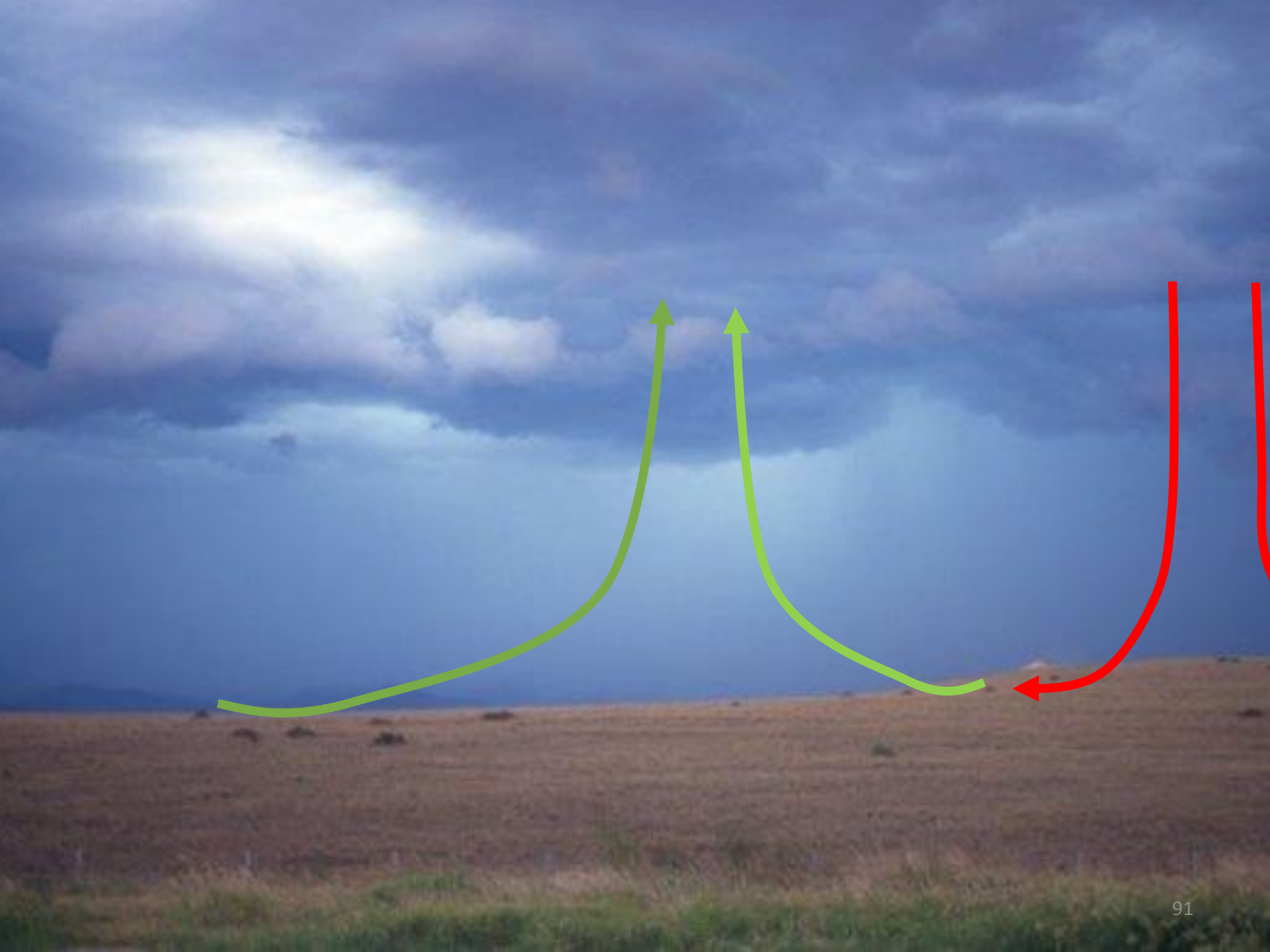
**Schematic of Surface Conditions Common with a Supercell Thunderstorm**



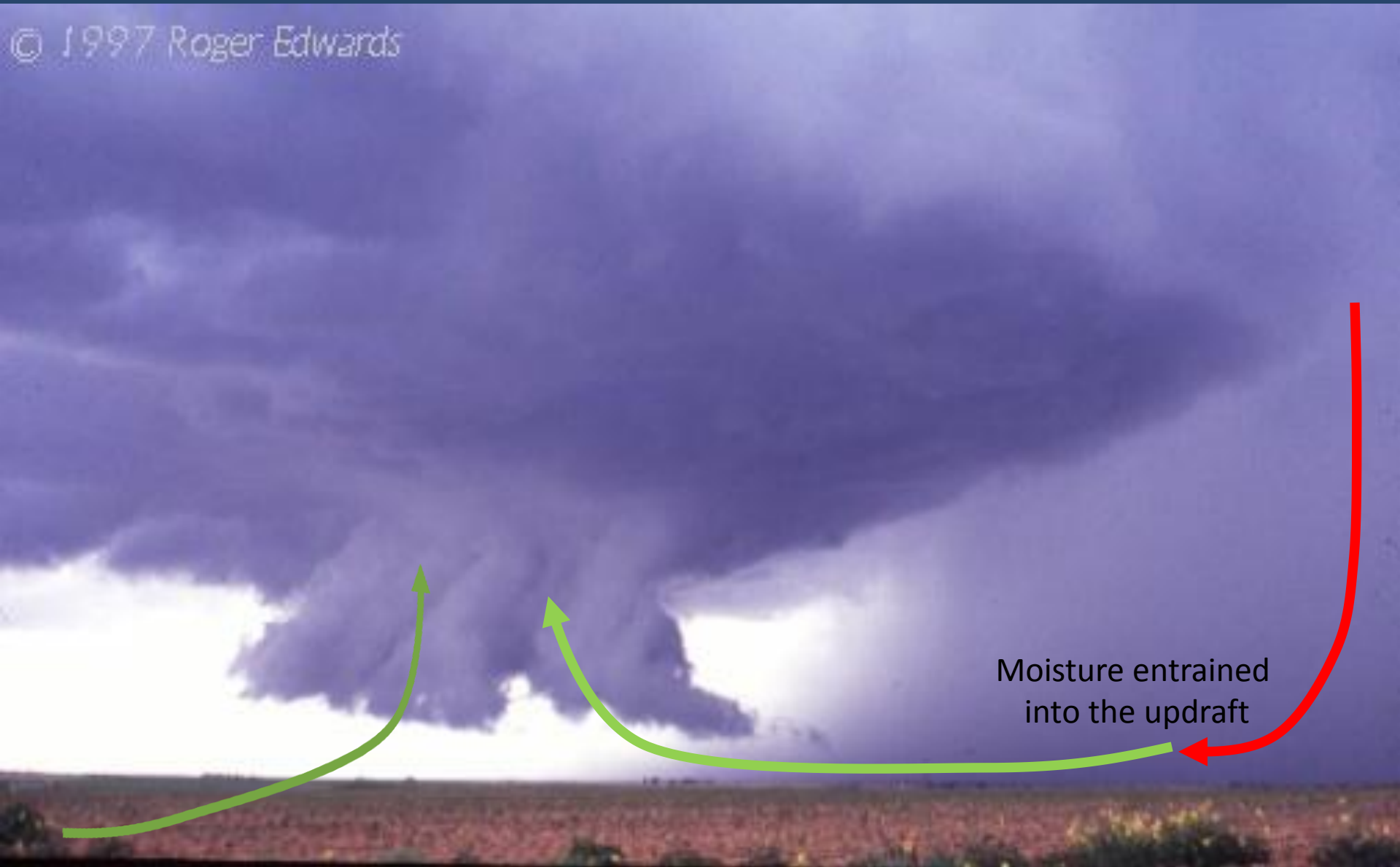
# What We Observe When Spotting Wall Cloud



- A wall cloud is nothing more than the base of an updraft.
- Downward sloping towards the precipitation.
- Organized Rotation?








Moisture entrained  
into the updraft

# What We Observe When Spotting Shelf Cloud



- A shelf cloud is the leading edge of a gust front that is moving out and away from the precipitation.
- Downward sloping away from the precipitation.
- Not rotating!



When the cool air from the  
downdraft reaches the surface....

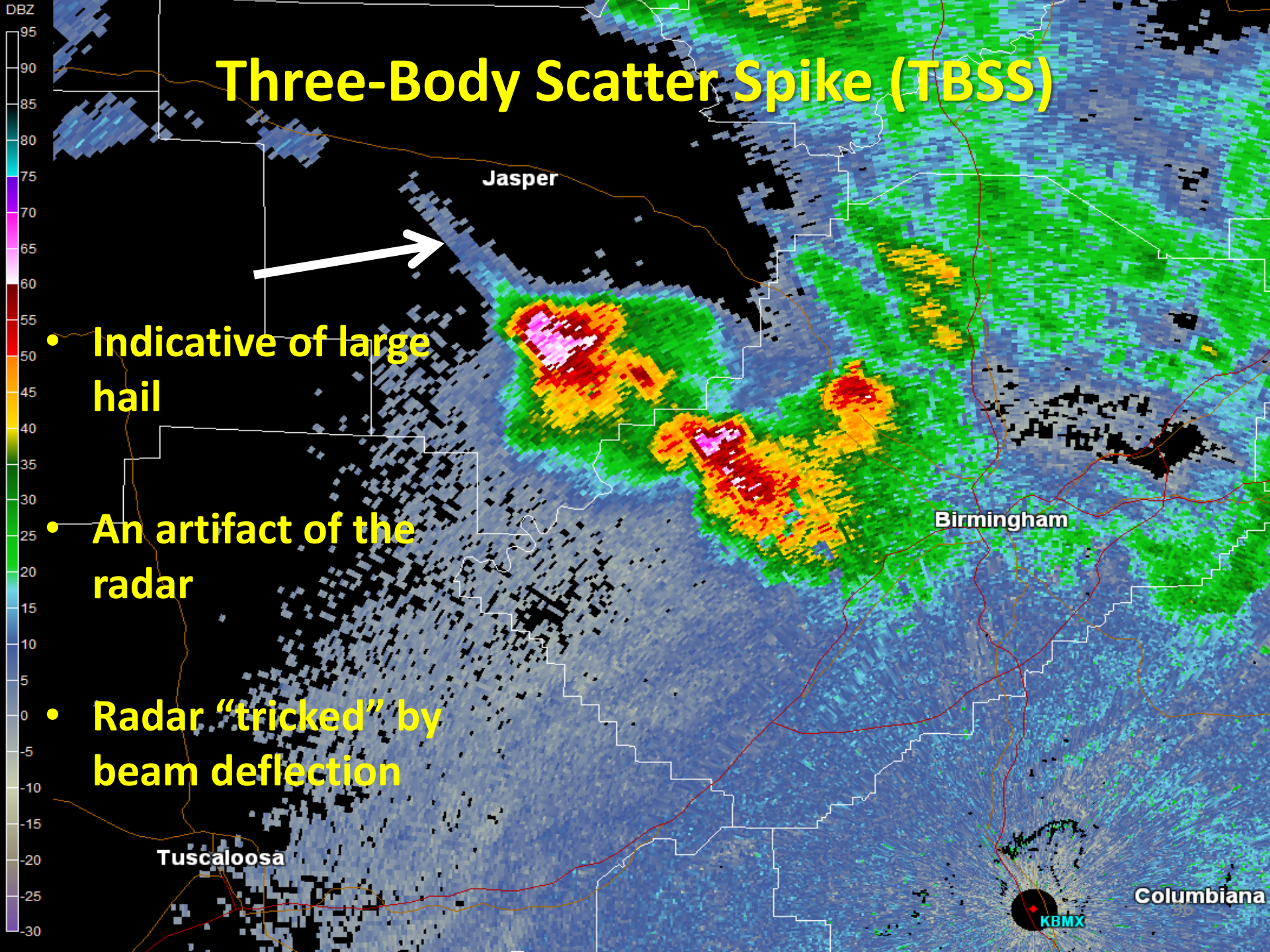
... it creates the outflow which pushes forward and  
provides lift for clouds to form (along the black line.

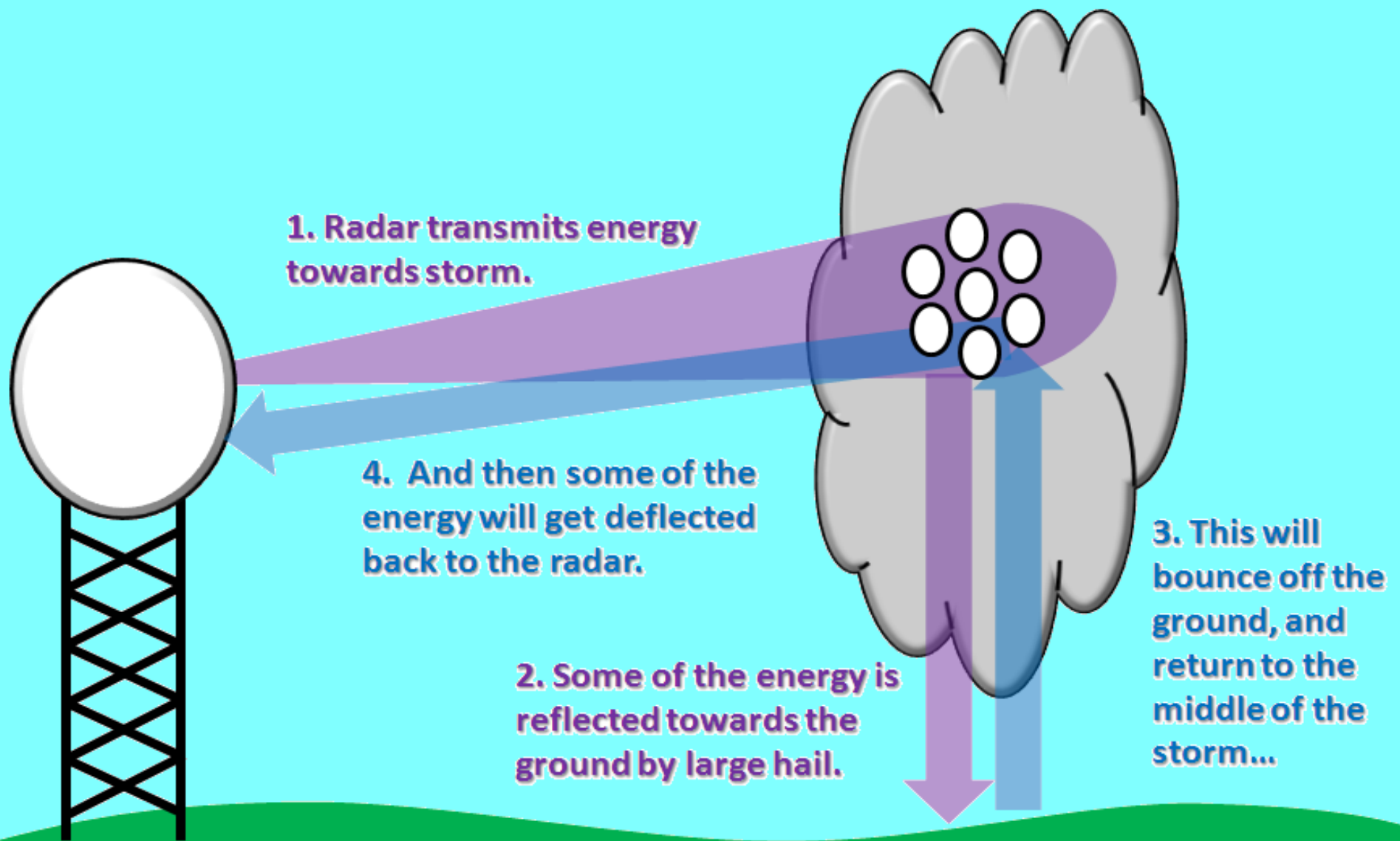


# **Radar Signatures**

# Three-Body Scatter Spike (TBSS)

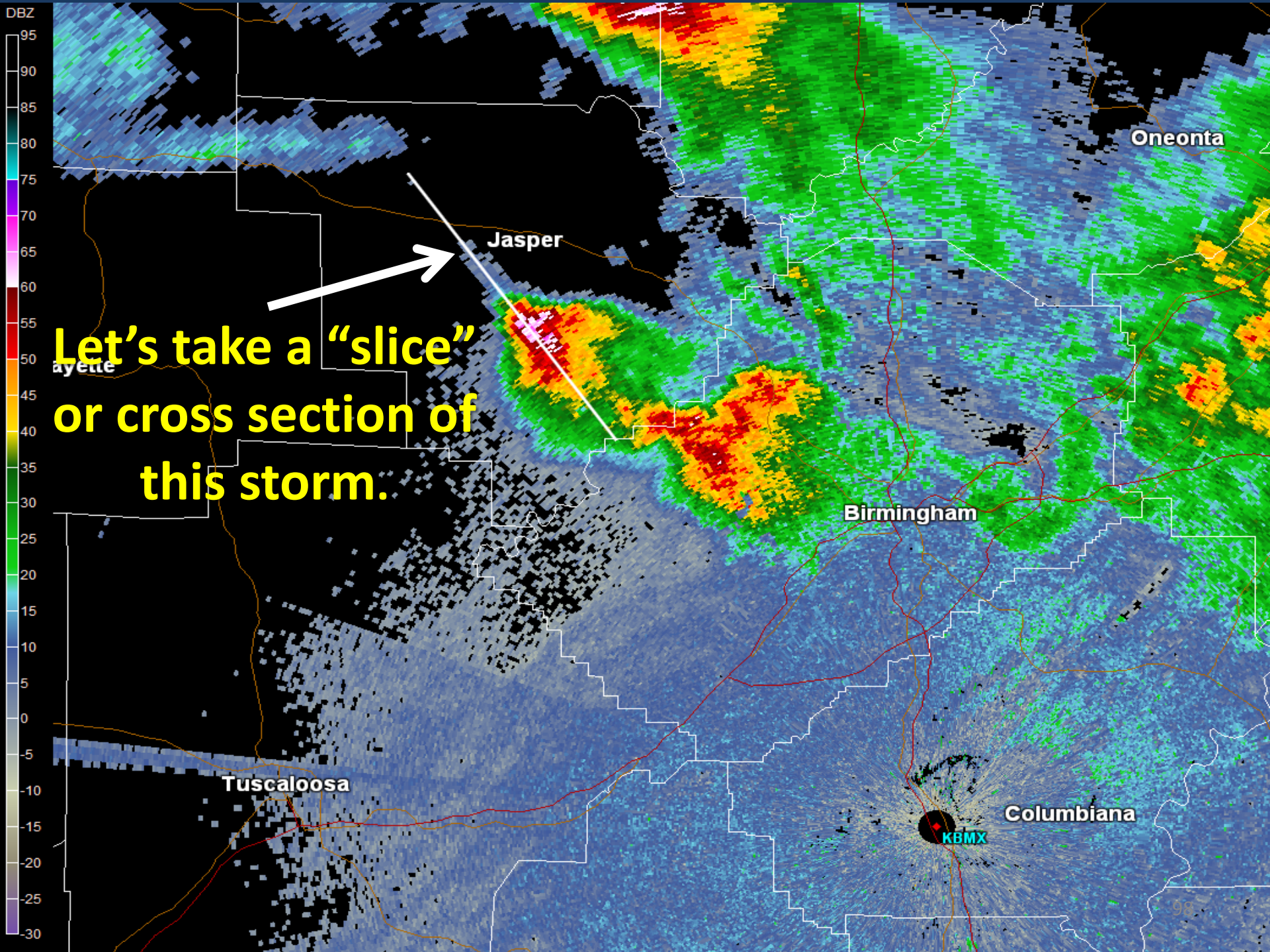
- Indicative of large hail
- An artifact of the radar
- Radar “tricked” by beam deflection





The extra time that it takes for the deflected energy to travel to the ground and back produces a false radar echo that extends like a spike along a line from the radar to the storm.





Let's take a "slice"  
or cross section of  
this storm.

Jasper

Oneonta

Birmingham

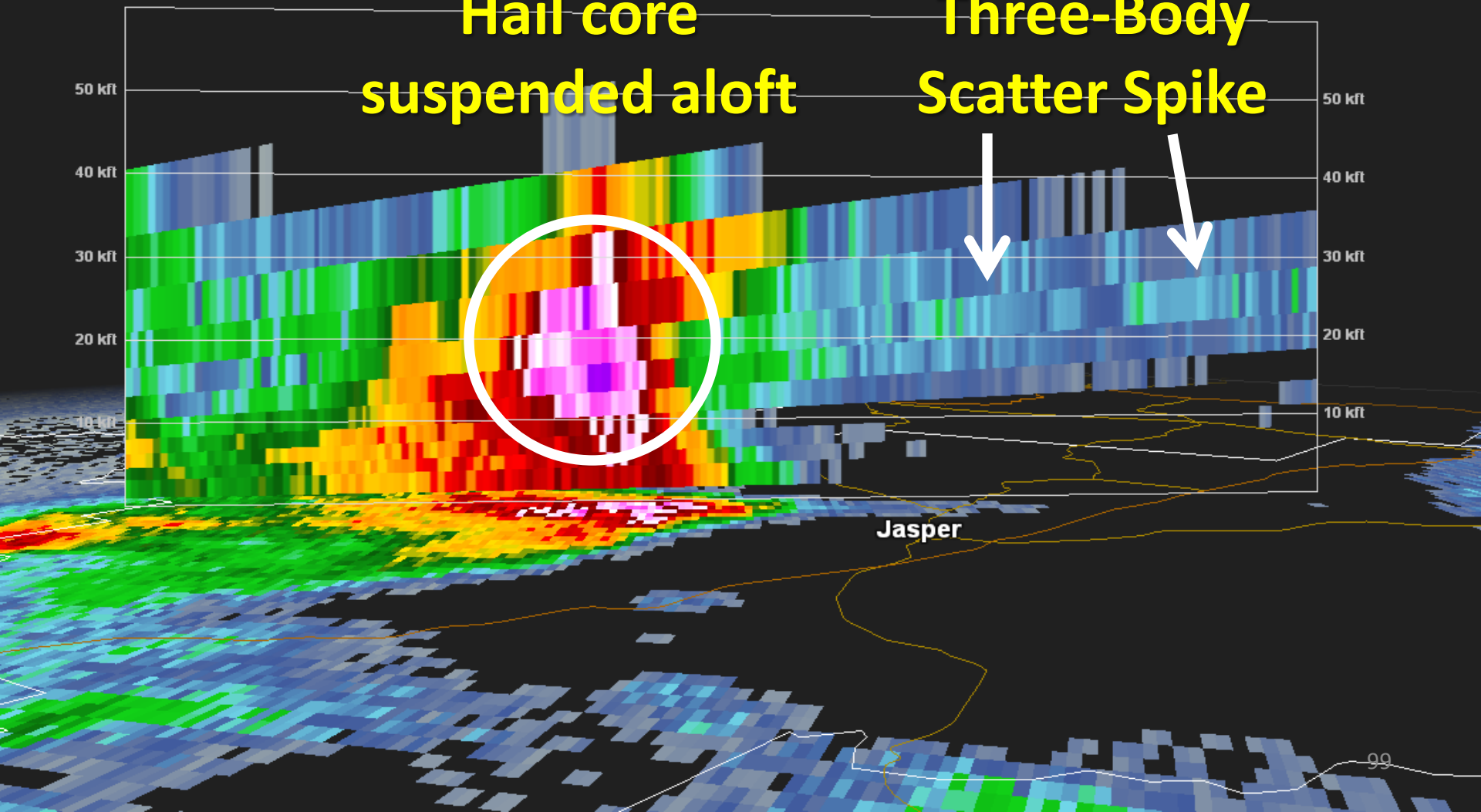
Tuscaloosa

Columbiana

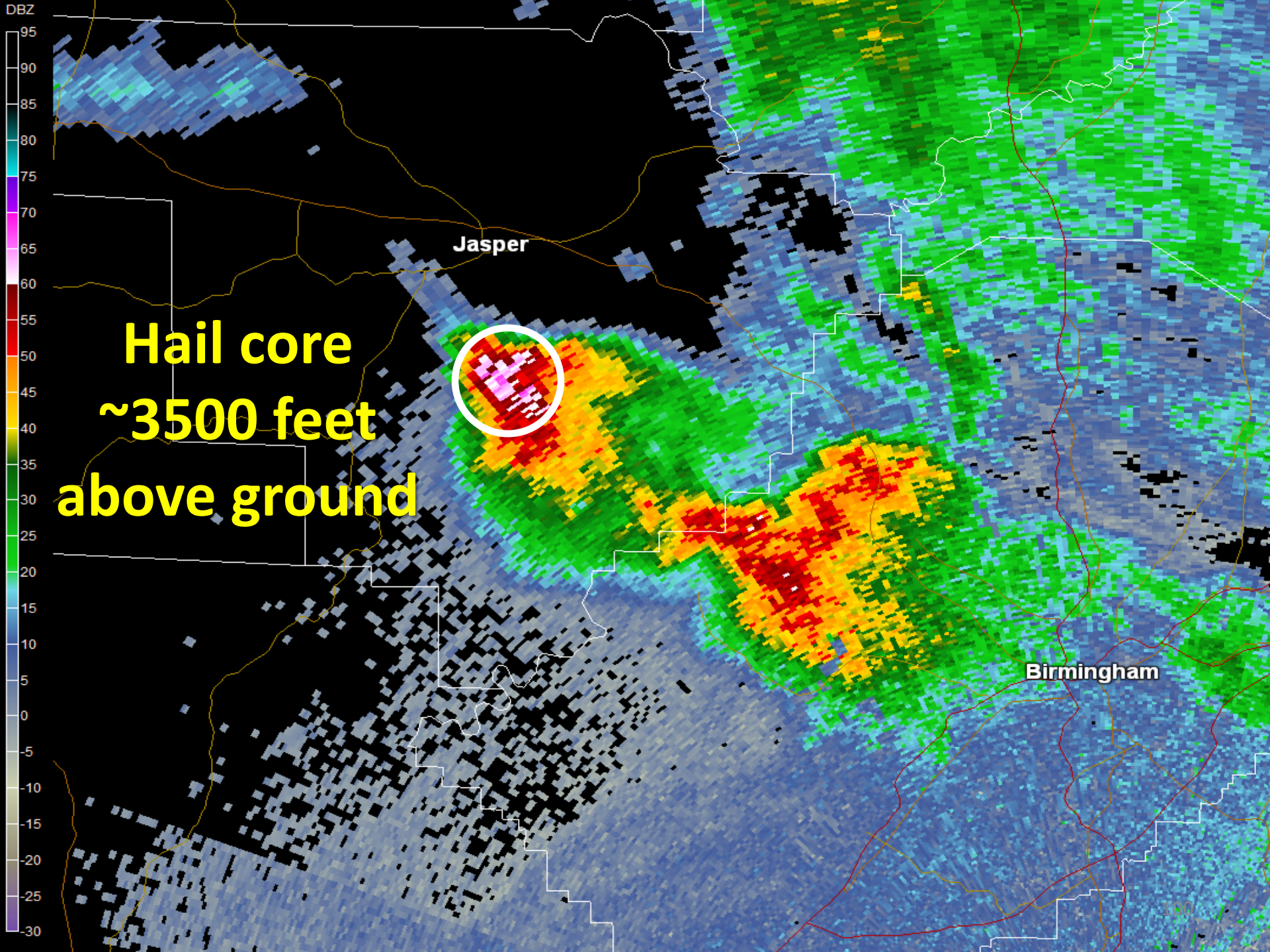
KBMX

**Hail core  
suspended aloft**

**Three-Body  
Scatter Spike**





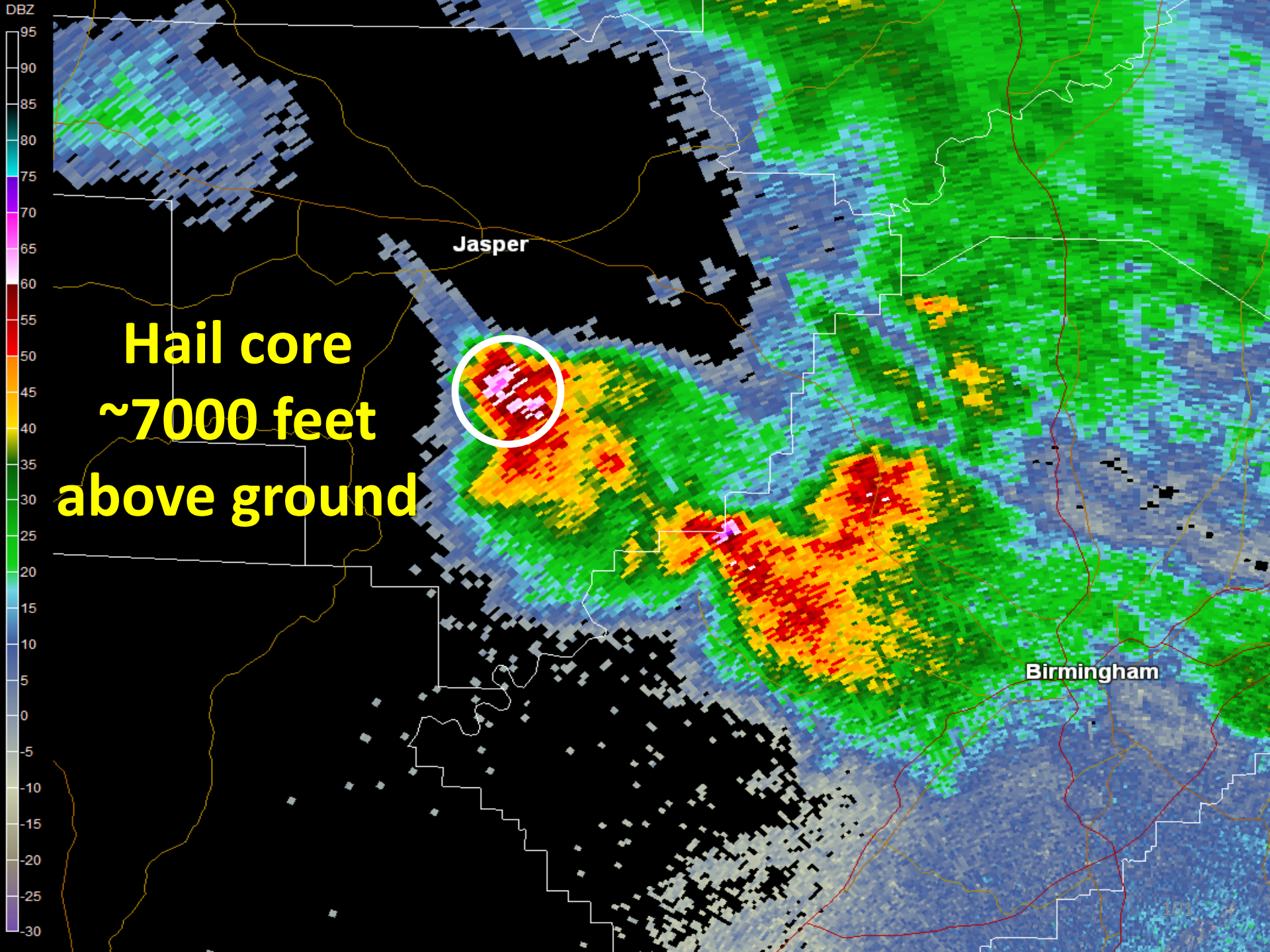


**Hail core  
~3500 feet  
above ground**

Jasper

Birmingham

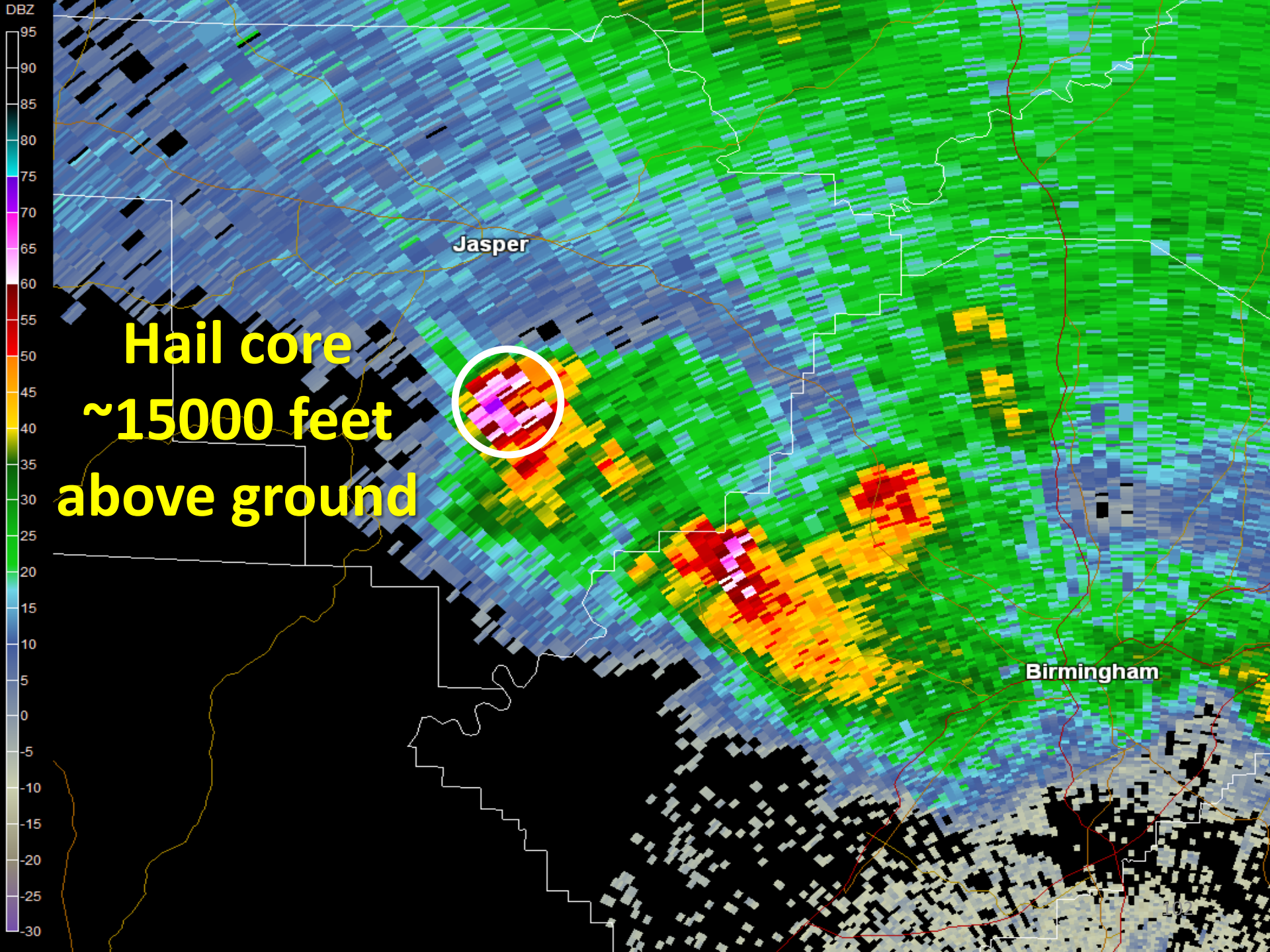




**Hail core  
~7000 feet  
above ground**

Jasper

Birmingham

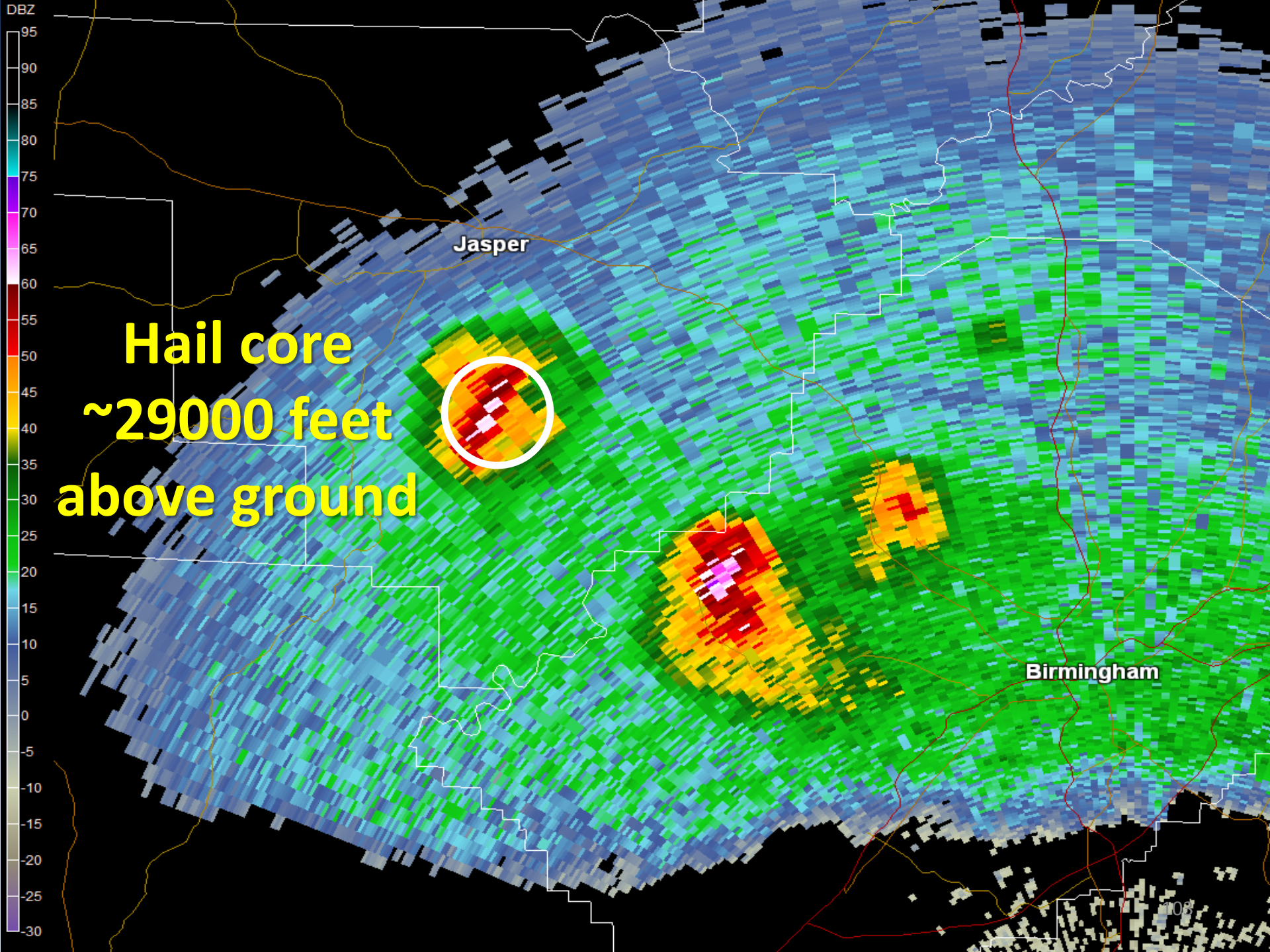


**Hail core  
~15000 feet  
above ground**

Jasper

Birmingham

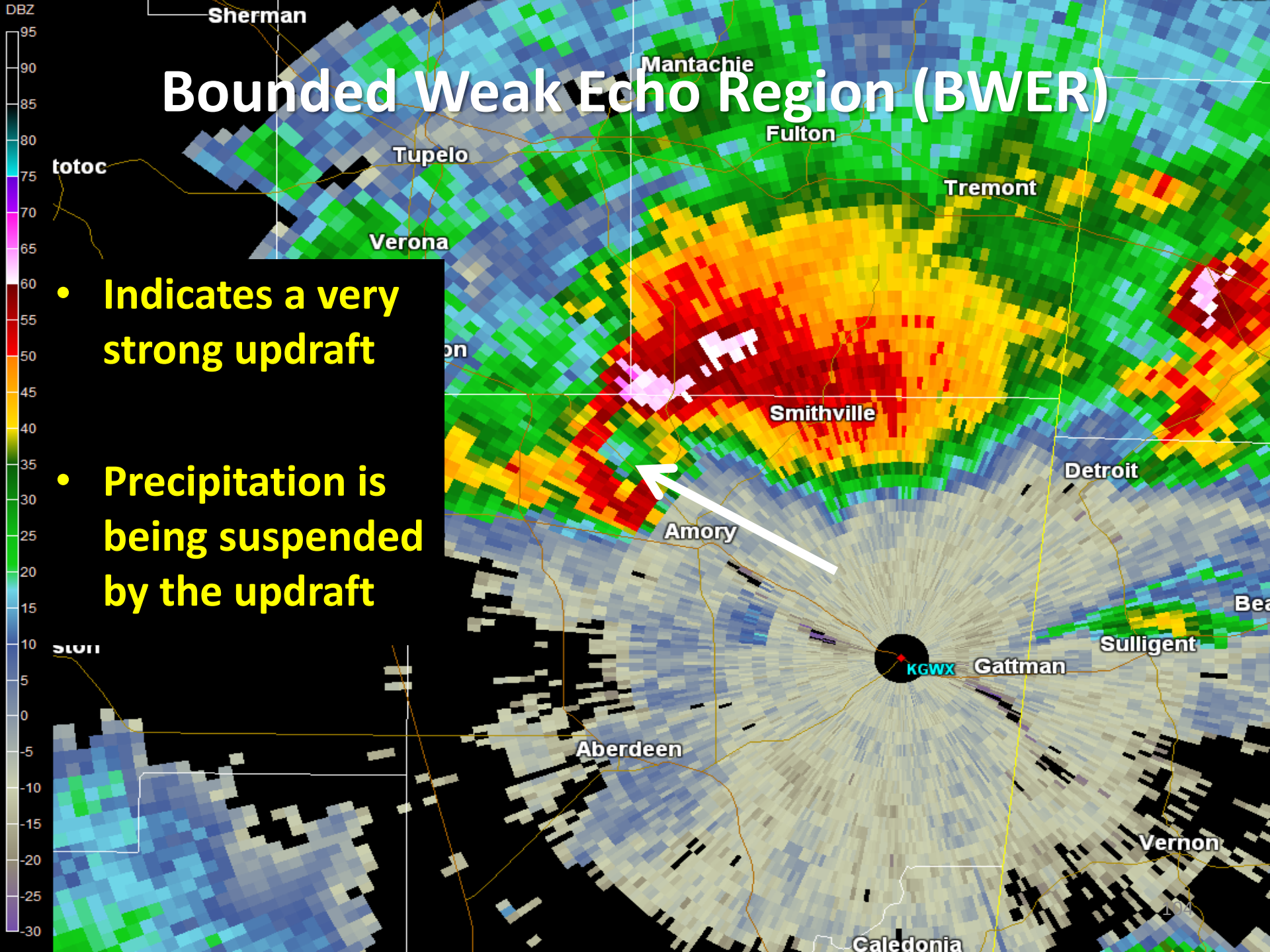




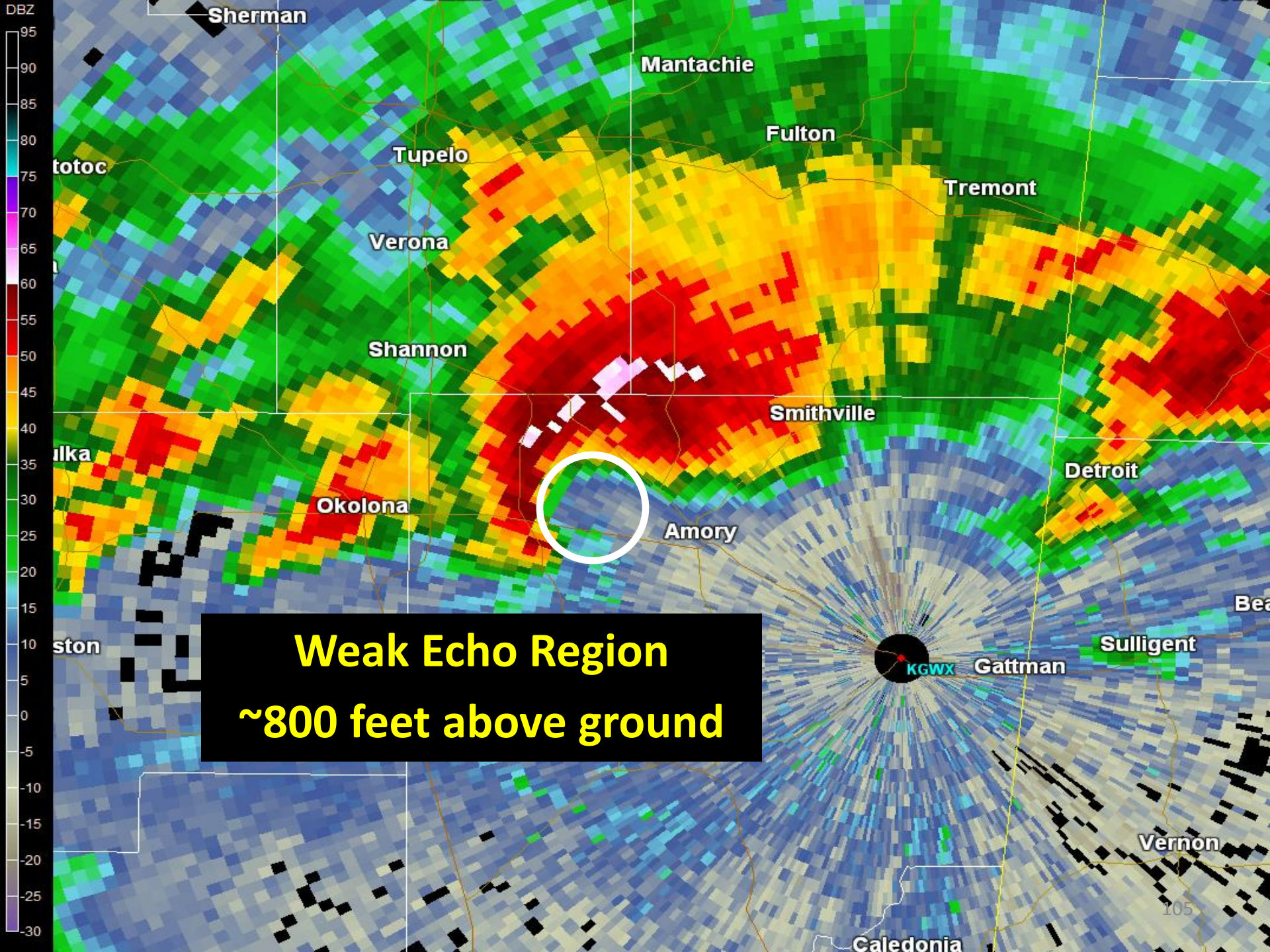


# Bounded Weak Echo Region (BWER)

- Indicates a very strong updraft
- Precipitation is being suspended by the updraft

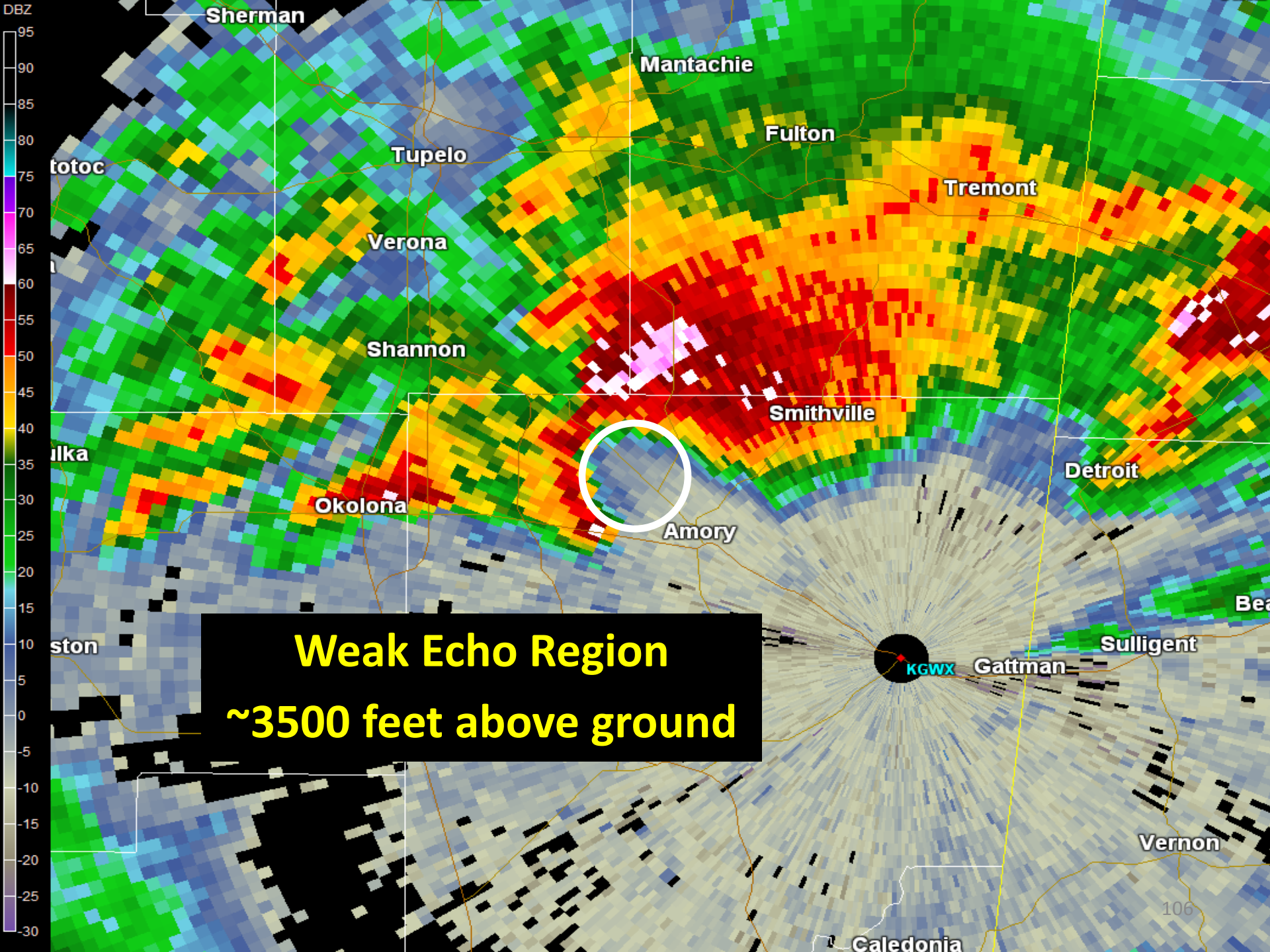




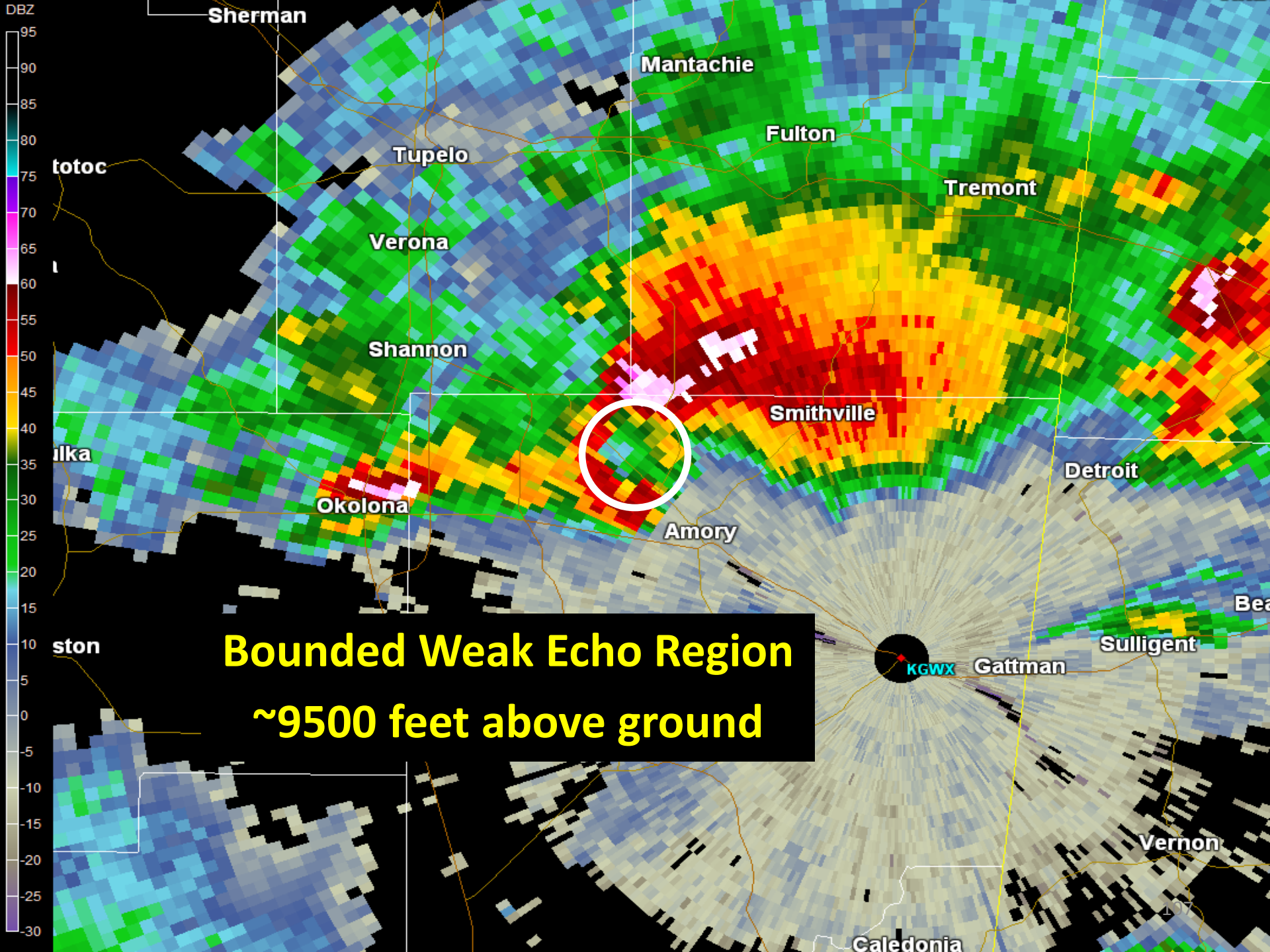


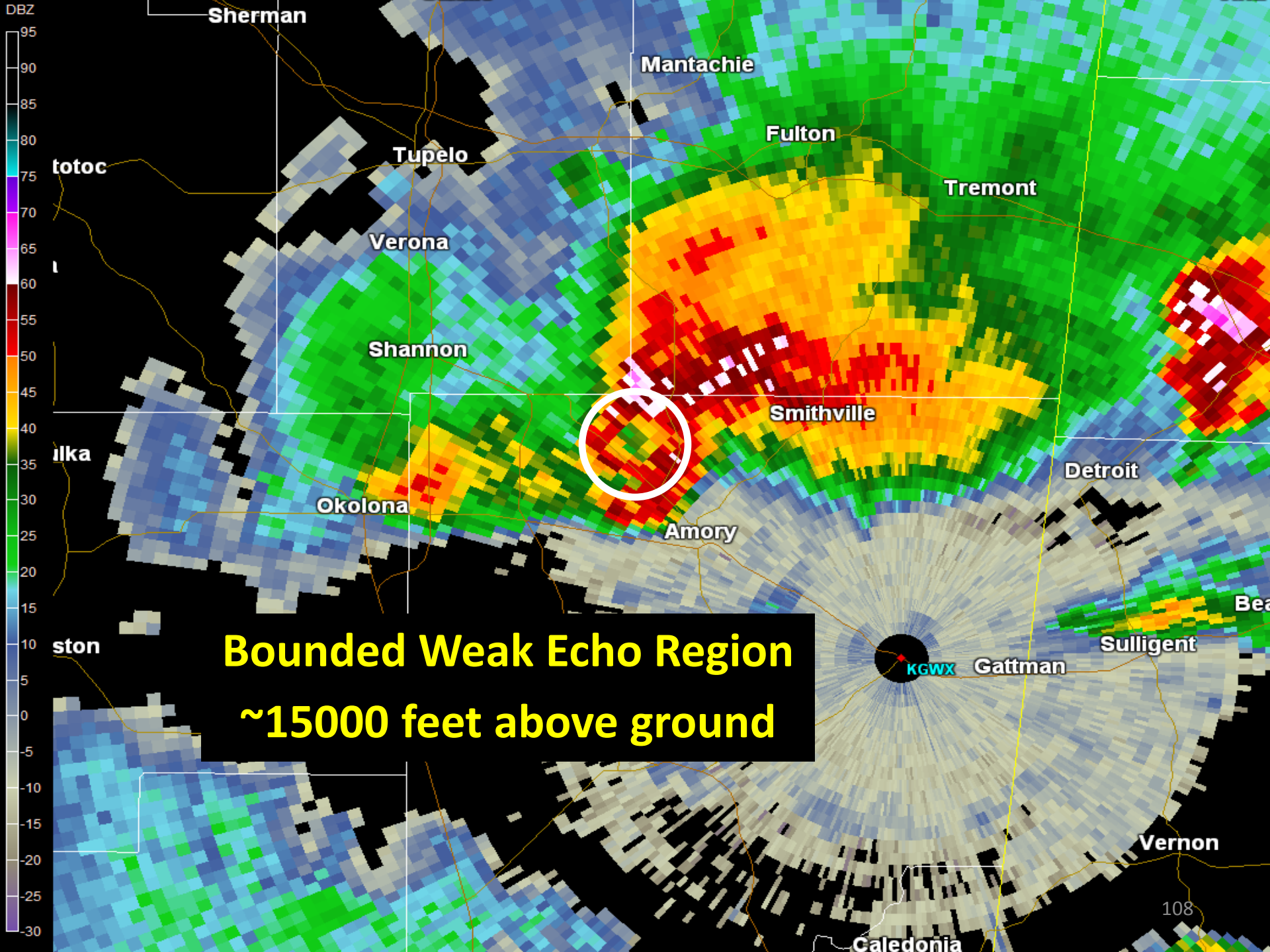
**Weak Echo Region**  
**~800 feet above ground**





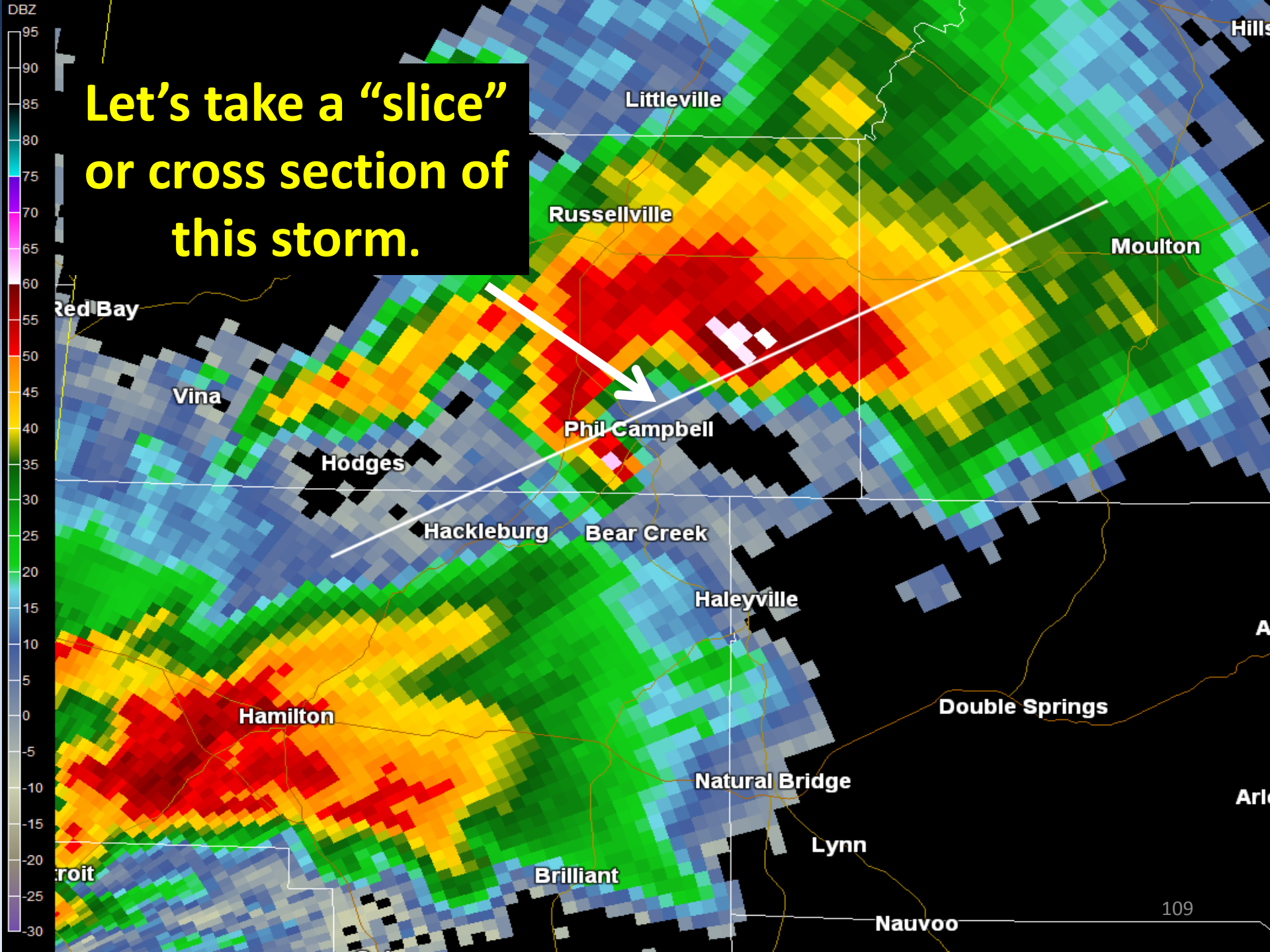




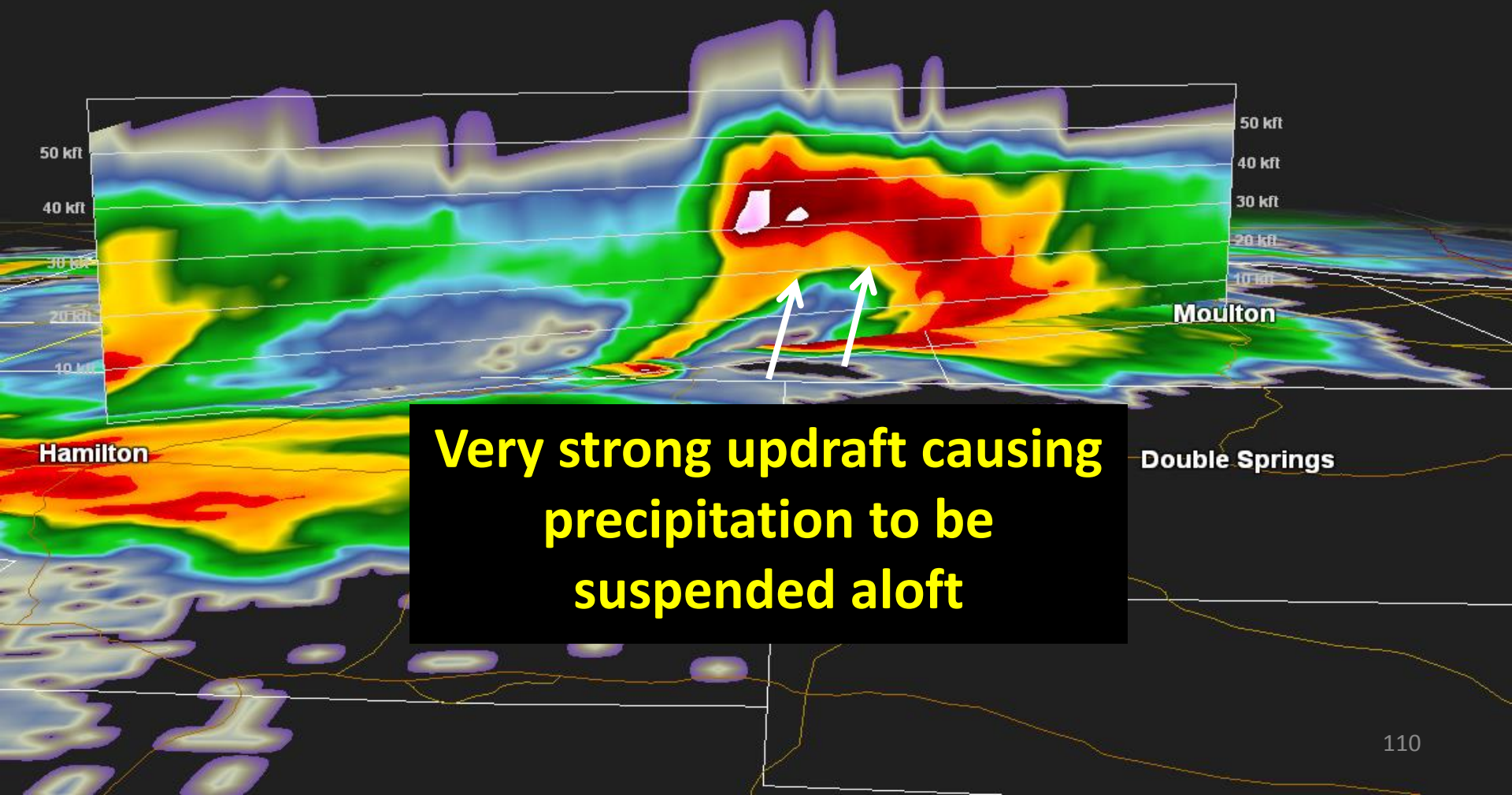




Let's take a "slice"  
or cross section of  
this storm.



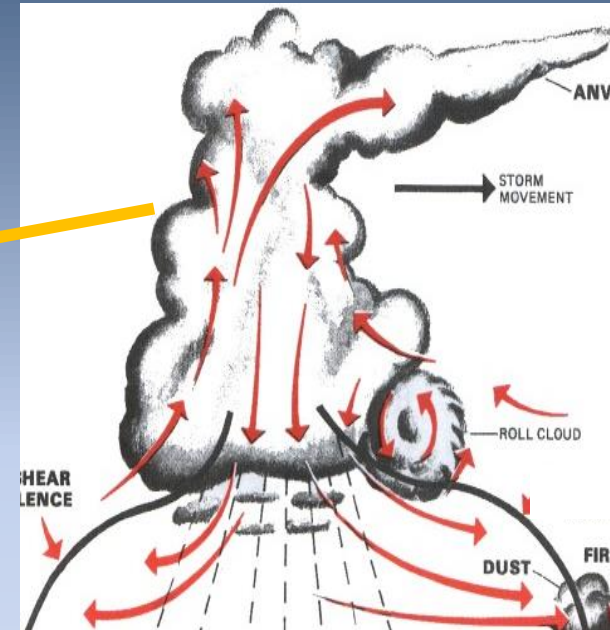
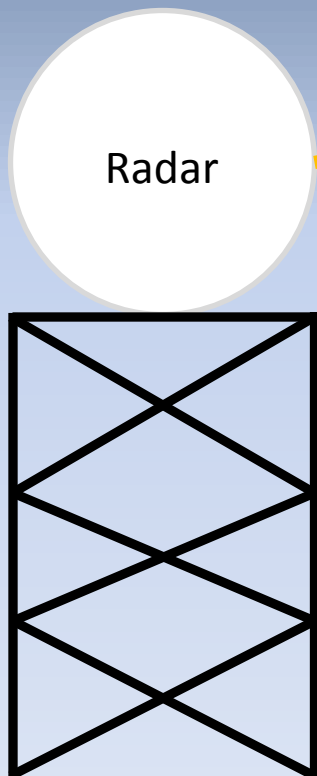




**Very strong updraft causing  
precipitation to be  
suspended aloft**

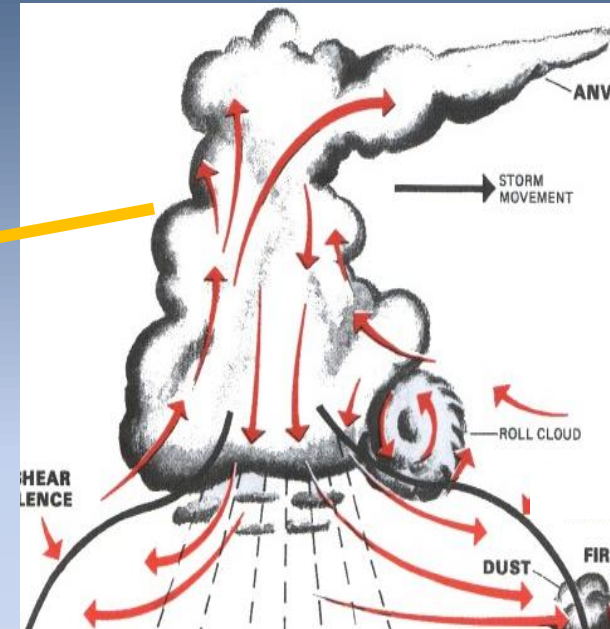
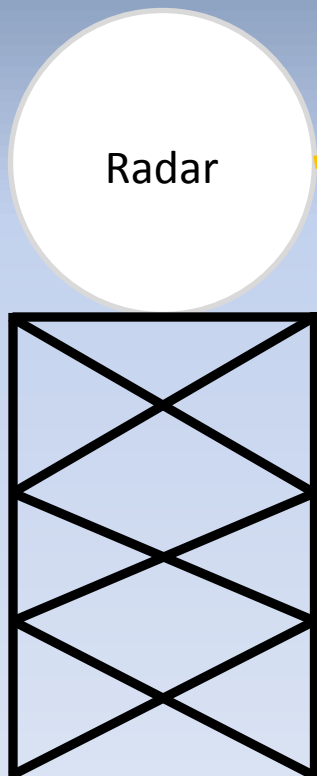
# Dual Polarization Concepts

# Dual Polarization

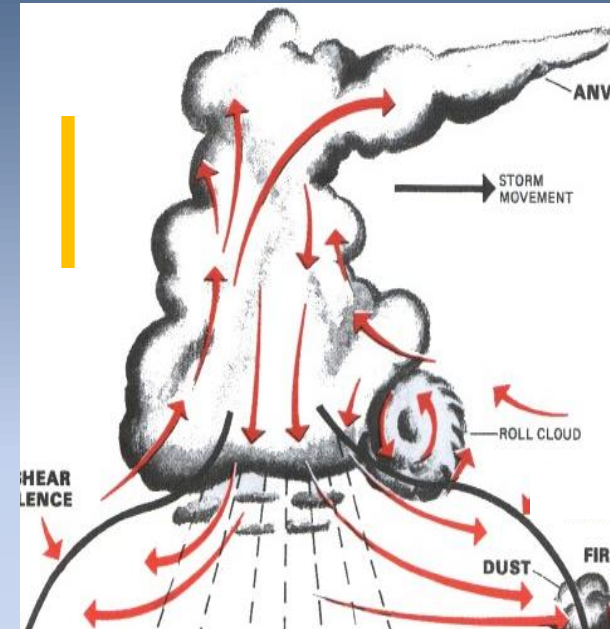
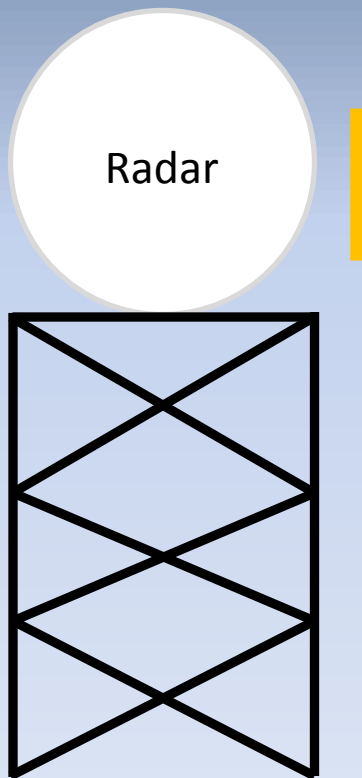




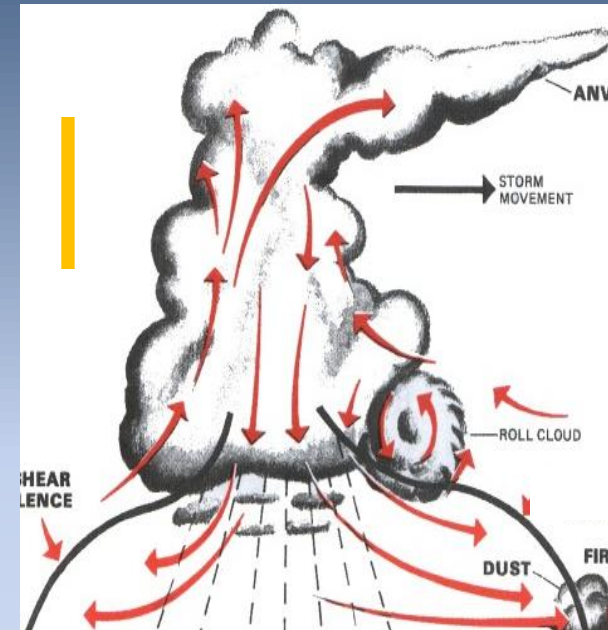
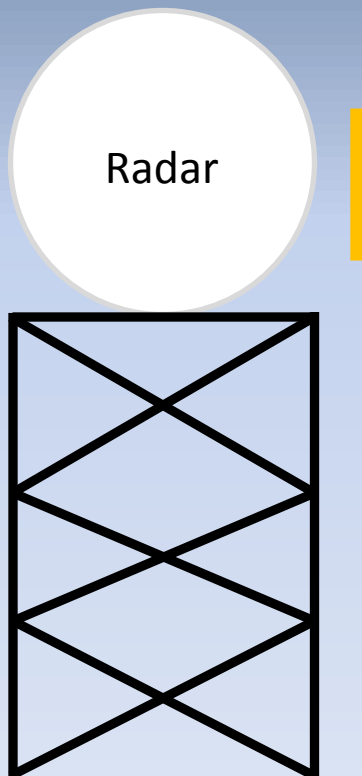
# Dual Polarization



# Dual Polarization

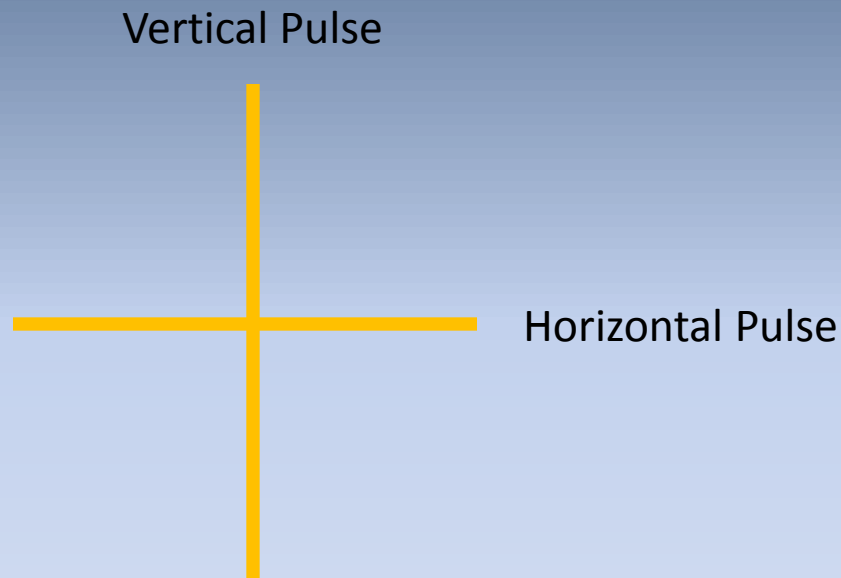


# Dual Polarization



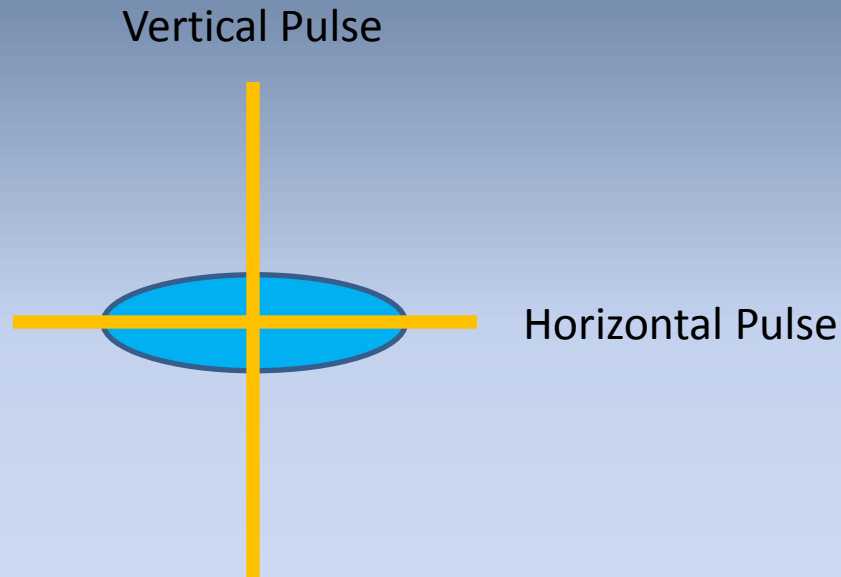


# Dual Pol: The Cross Section



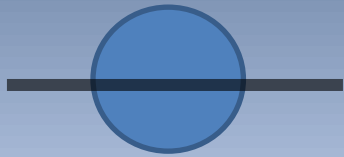
Targets measured in a ratio:  
Example: Hail stone of 3 in X 3 in  
Ratio: 3 to 3 or 1 to 1  
or the target has the same height and width

# Dual Pol: The Cross Section

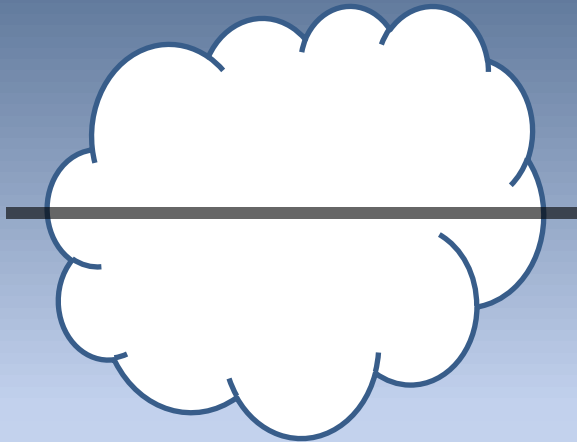


Raindrops are flattened as they fall  
Targets measured in a ratio:  
Example: width of 3, height of 1 or  
a ratio of 3 to 1

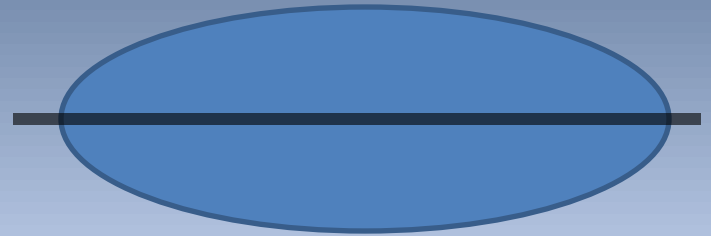
# Horizontal Scanning



H: 30 dBz



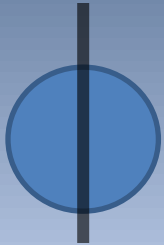
H: 60 dBz



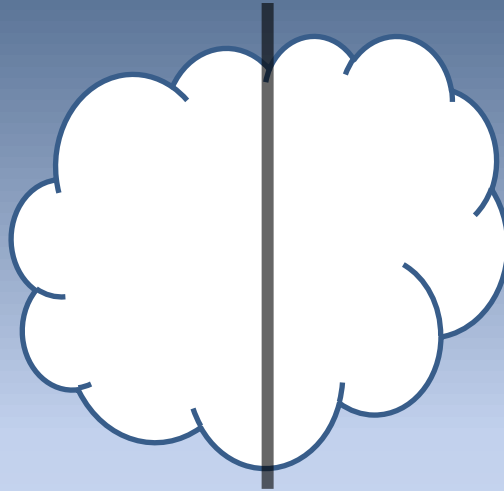
H: 60 dBz



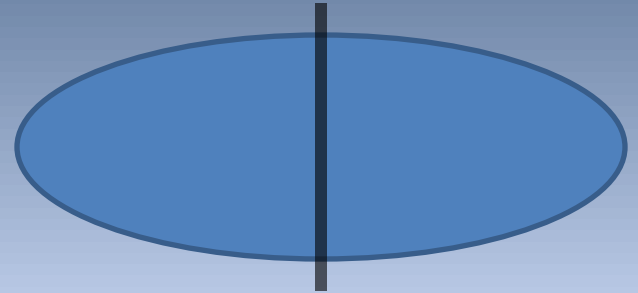
# Vertical Scanning



V: 30 dBz

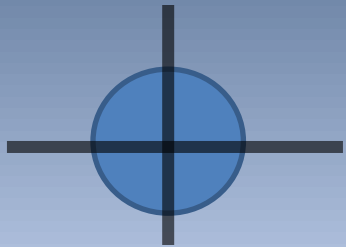


V: 60 dBz



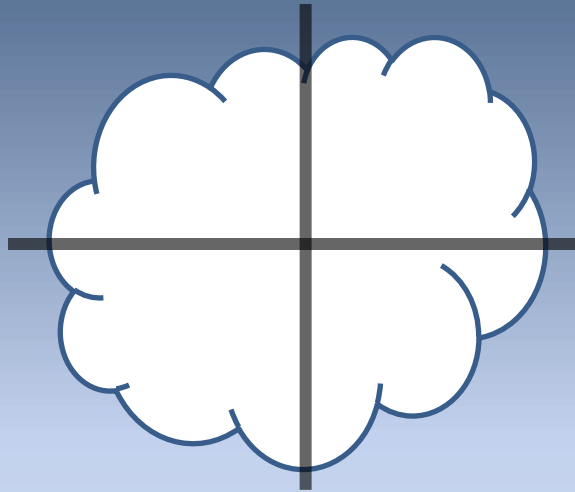
V: 30 dBz

# Horizontal and Vertical Scanning



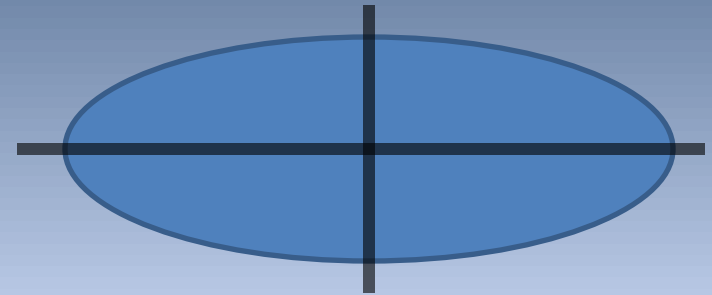
H: 30 dBz  
V: -30 dBz  
0 dBz

Small Drops



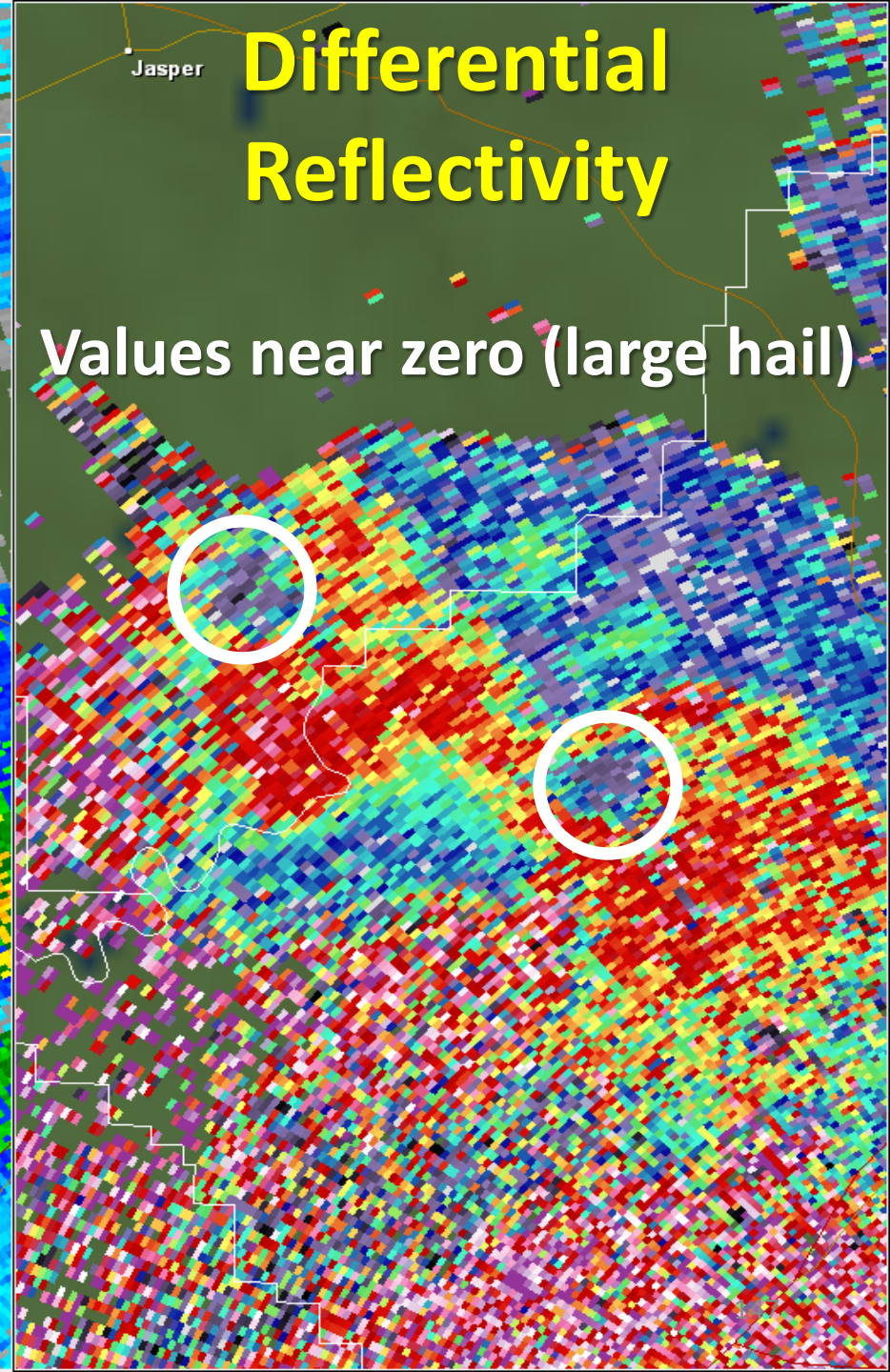
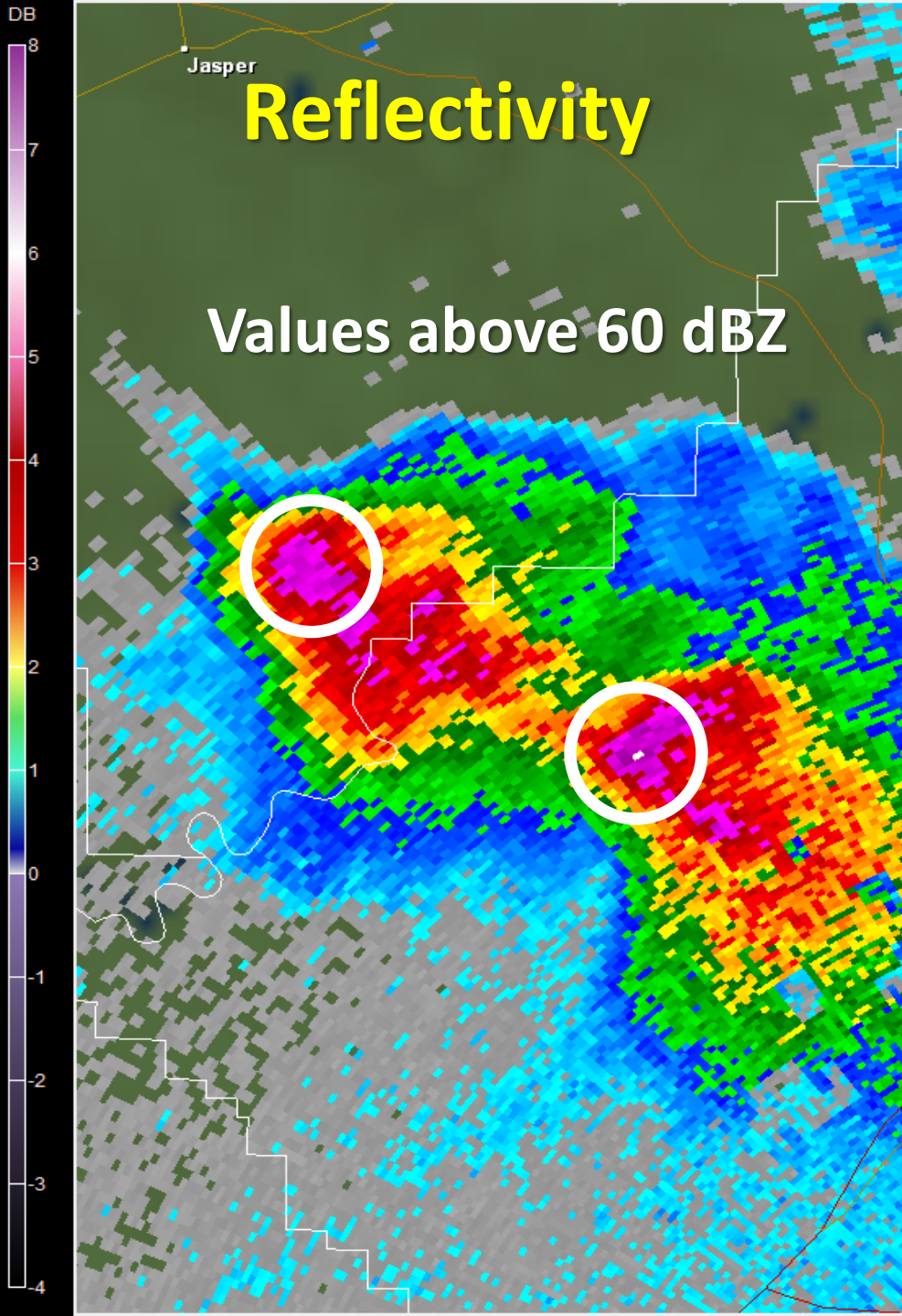
H: 60 dBz  
V: -60 dBz  
0 dBz

Hail



H: 60 dBz  
V: -30 dBz  
30 dBz

Large Drops



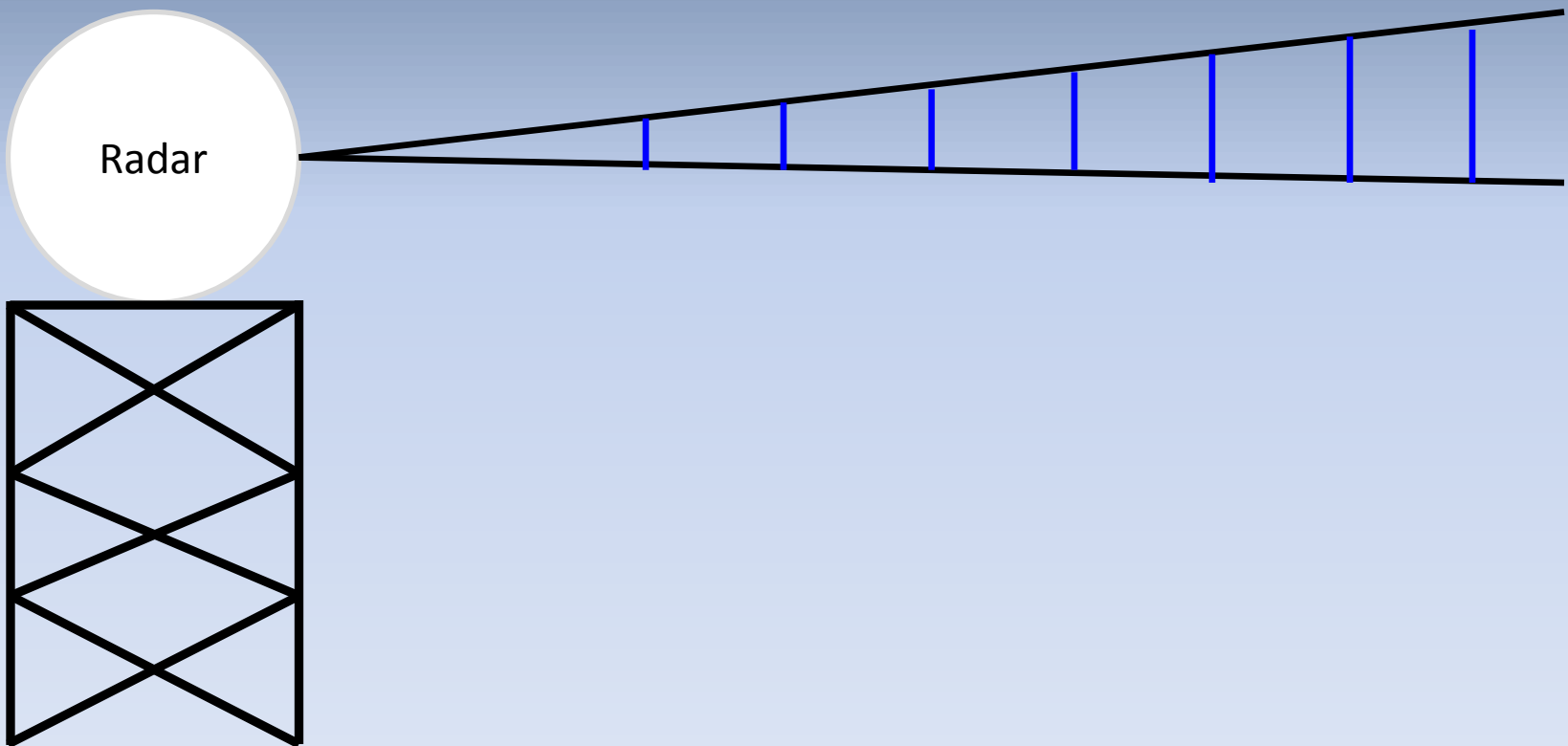


# The Dual Pol Cross Section

- Allows us to determine the difference between targets in the atmosphere
  - Do we have hail or rain?
- Product called Differential Reflectivity
  - Improved ability to measure rainfall
- Called them targets because rain/hail aren't necessarily the only thing in the air

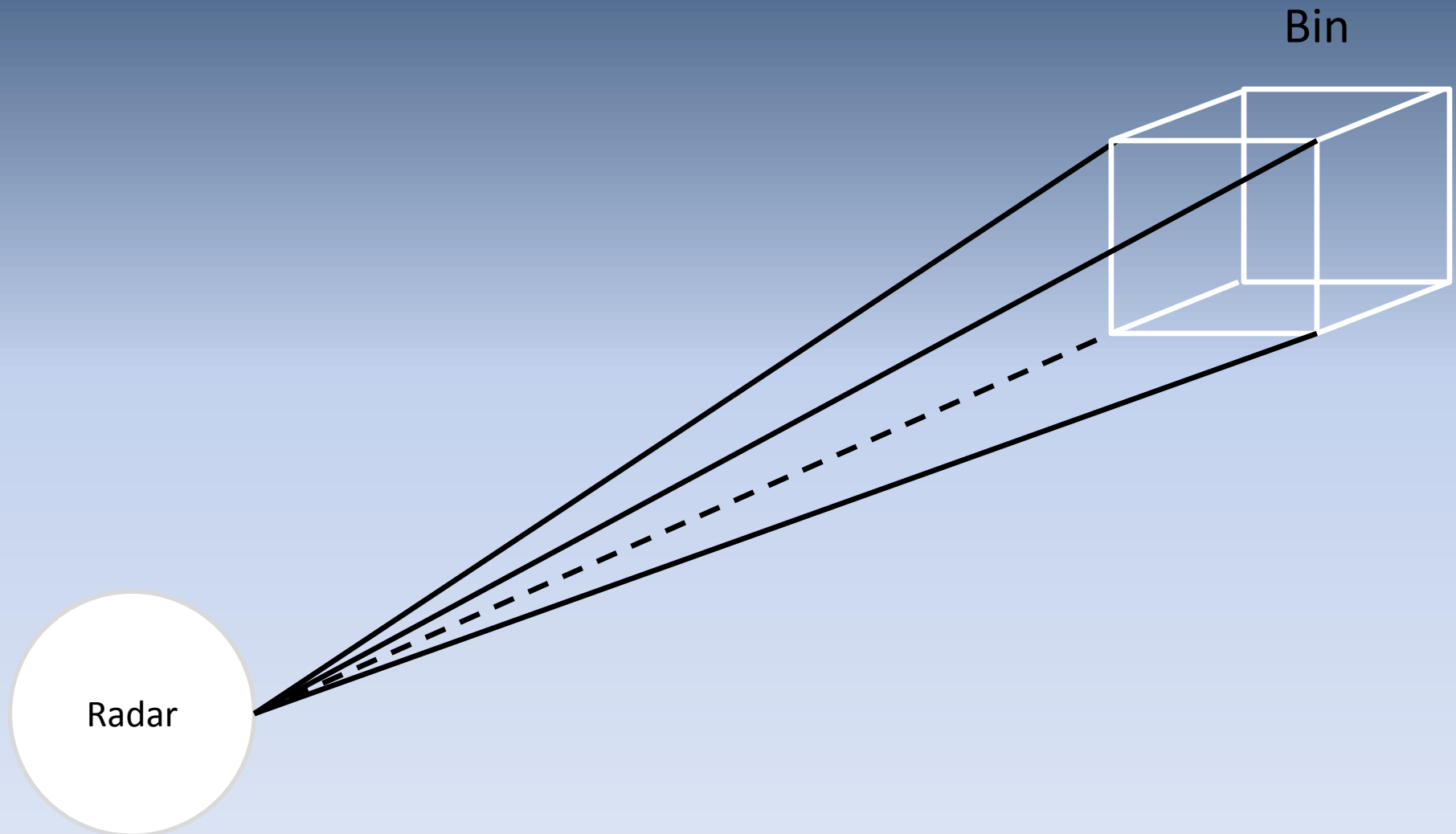


# Dual Polarization



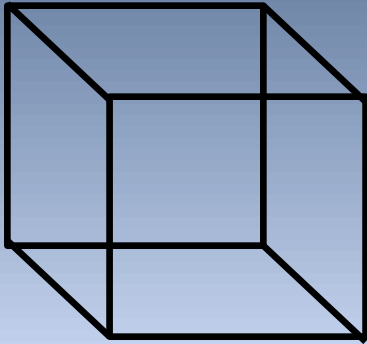


# Dual Polarization



# Dual Polarization

Bin



Ratio 3 to 1



Ratio 1 to 1



Ratio ???

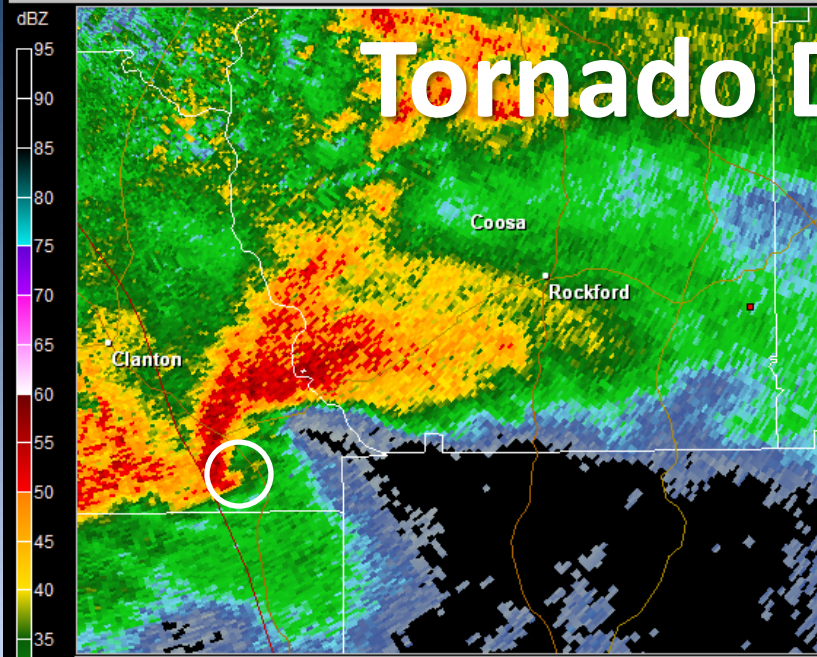
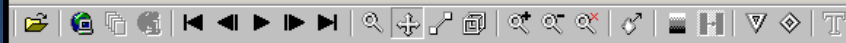
Wood, Insulation, Leaves,  
Twigs, Paper, etc.

# Correlation Coefficient

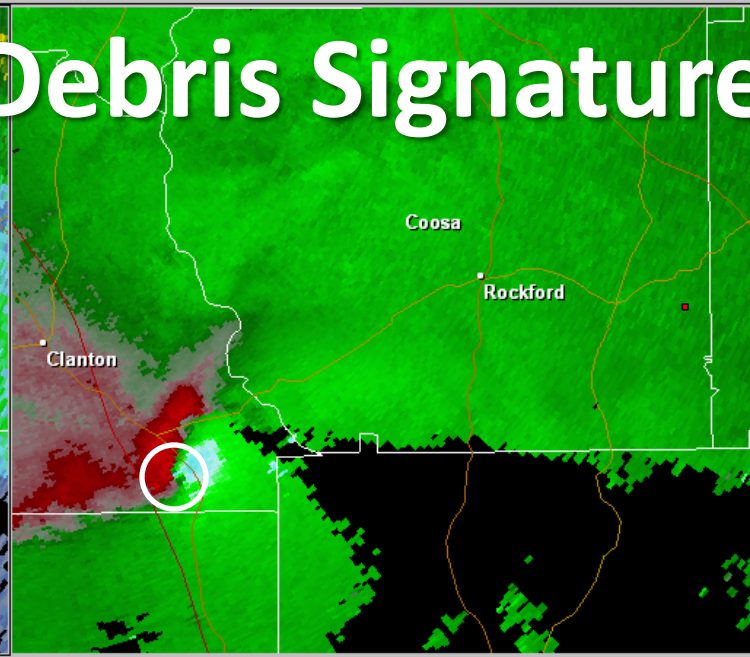
- All of those targets are in the bin and the radar has to distinguish between them
- It calculates the ratios of all those targets
- When you have all different kinds of targets in a bin, and their ratios are not correlated.
  - Correlation Coefficient of that bin is LOWERED

TORNADO DEBRIS SIGNATURE





# Tornado Debris Signature



Site: KBMX  
VST: 03/03/2012 04:03:42 Z  
Prod: 03/03/2012 04:03:39 Z  
VCP: 212 SMV: 252° 47 kts  
Tilt: 0.538°

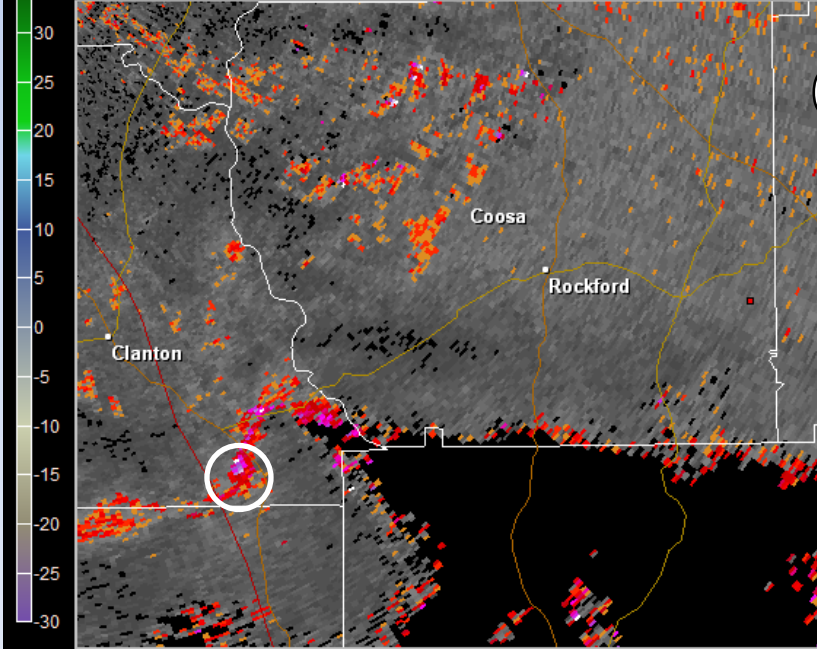
- Select Product:
- |                                     |                            |                           |
|-------------------------------------|----------------------------|---------------------------|
| <input checked="" type="radio"/> BR | <input type="radio"/> VIL  | <input type="radio"/> ZDR |
| <input type="radio"/> BV            | <input type="radio"/> VILD | <input type="radio"/> RHO |
| <input type="radio"/> SRV           | <input type="radio"/> POSH | <input type="radio"/> PHI |
| <input type="radio"/> SW            | <input type="radio"/> MEHS | <input type="radio"/> KDP |
| <input type="radio"/> ET            | <input type="radio"/> NROI | <input type="radio"/> HCA |

- Select Tilt:
- |       |       |       |       |
|-------|-------|-------|-------|
| 0.5°  | 0.9°  | 1.4°  | 1.8°  |
| 2.4°  | 3.2°  | 4.0°  | 5.1°  |
| 6.4°  | 8.0°  | 10.0° | 12.5° |
| 15.6° | 19.5° |       |       |

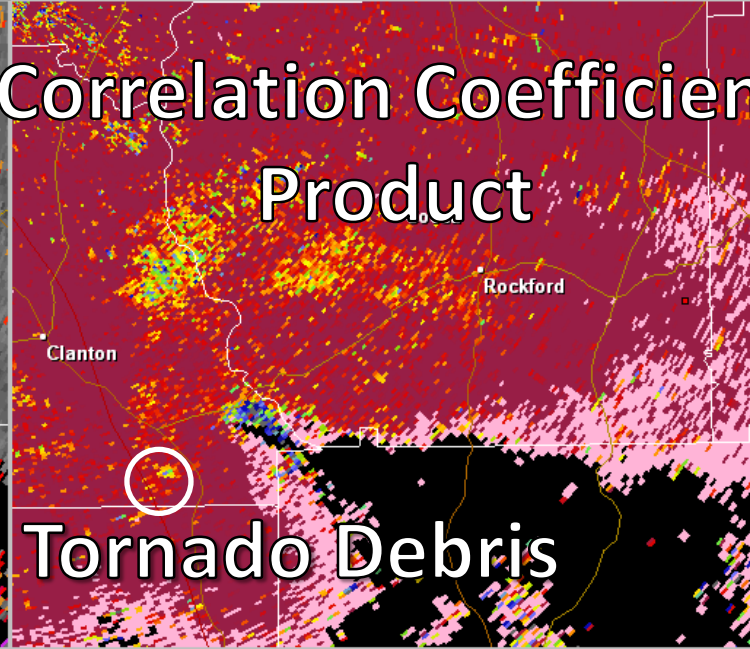
- Warnings:
- |  |
|--|
| <input checked="" type="checkbox"/> Marine - 0       |
| <input type="checkbox"/> Flash Flood - 0             |
| <input checked="" type="checkbox"/> Thunderstorm - 0 |
| <input checked="" type="checkbox"/> Tornado - 0      |

Product Details:

Max: 63.0 dbz  
Az: 305.2°  
Ran: 39.0 nm

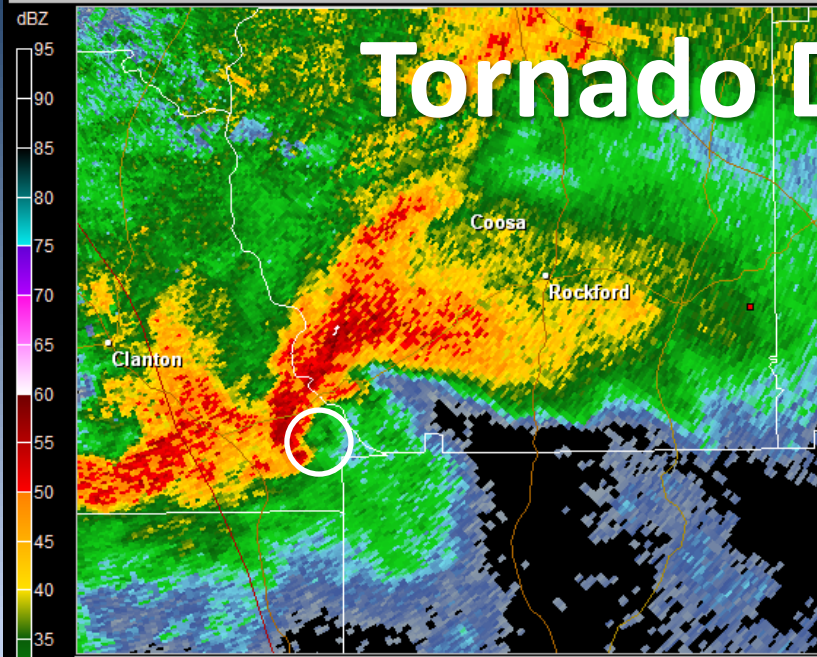
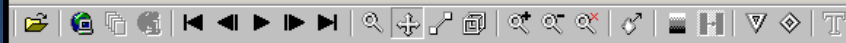


# Correlation Coefficient Product

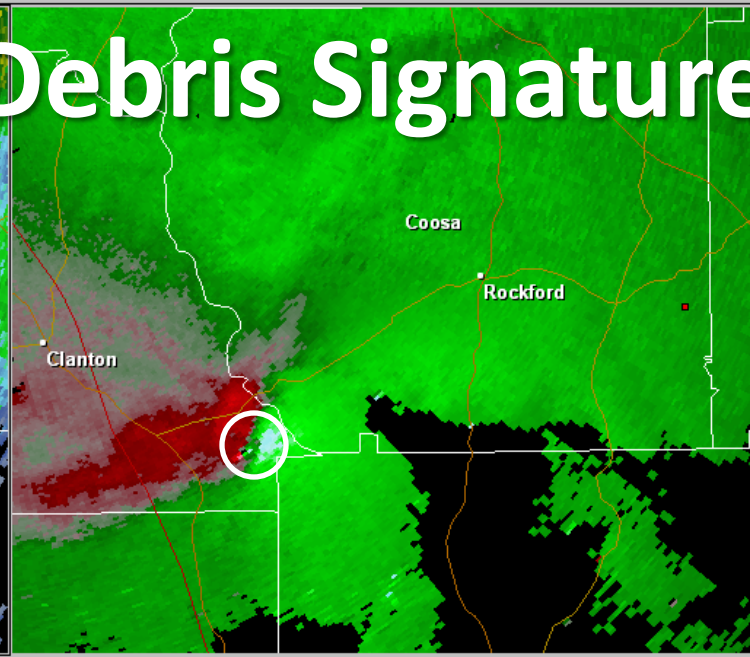


# Tornado Debris





# Tornado Debris Signature



Site: KBMX  
VST: 03/03/2012 04:08:21 Z  
Prod: 03/03/2012 04:08:17 Z  
VCP: 212 SMV: 252° 47 kts  
Tilt: 0.527°

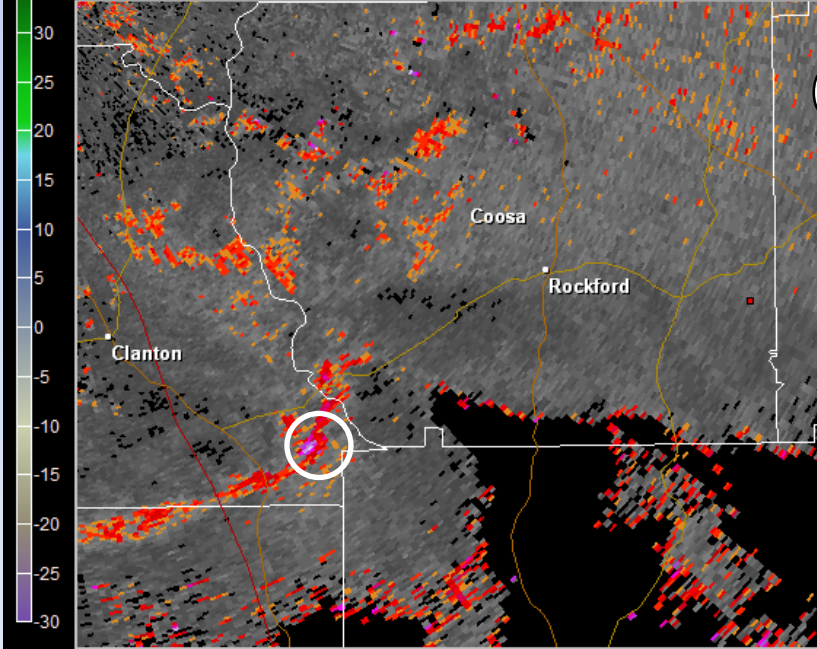
- Select Product:
- |                                     |                            |                           |
|-------------------------------------|----------------------------|---------------------------|
| <input checked="" type="radio"/> BR | <input type="radio"/> VIL  | <input type="radio"/> ZDR |
| <input type="radio"/> BV            | <input type="radio"/> VIL  | <input type="radio"/> RHO |
| <input type="radio"/> SRV           | <input type="radio"/> POSH | <input type="radio"/> PHI |
| <input type="radio"/> SW            | <input type="radio"/> MEHS | <input type="radio"/> KDP |
| <input type="radio"/> ET            | <input type="radio"/> NROI | <input type="radio"/> HCA |

- Select Tilt:
- |       |       |       |       |
|-------|-------|-------|-------|
| 0.5°  | 0.9°  | 1.3°  | 1.8°  |
| 2.4°  | 3.2°  | 4.0°  | 5.2°  |
| 6.4°  | 8.0°  | 10.0° | 12.5° |
| 15.6° | 19.5° |       |       |

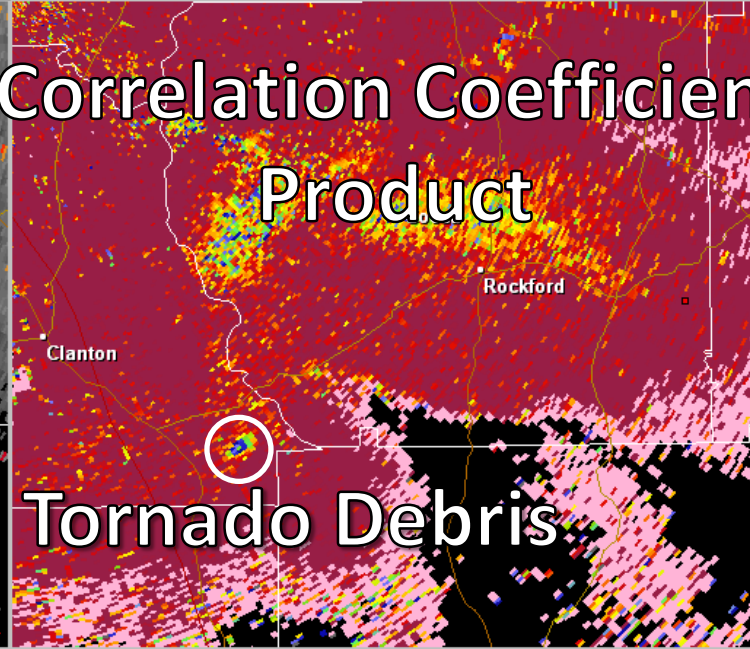
- Warnings:
- |  |
|--|
| <input checked="" type="checkbox"/> Marine - 0       |
| <input type="checkbox"/> Flash Flood - 0             |
| <input checked="" type="checkbox"/> Thunderstorm - 0 |
| <input checked="" type="checkbox"/> Tornado - 0      |

Product Details:

Max: 63.5 dbz  
Az: 307.2°  
Ran: 38.0 nm

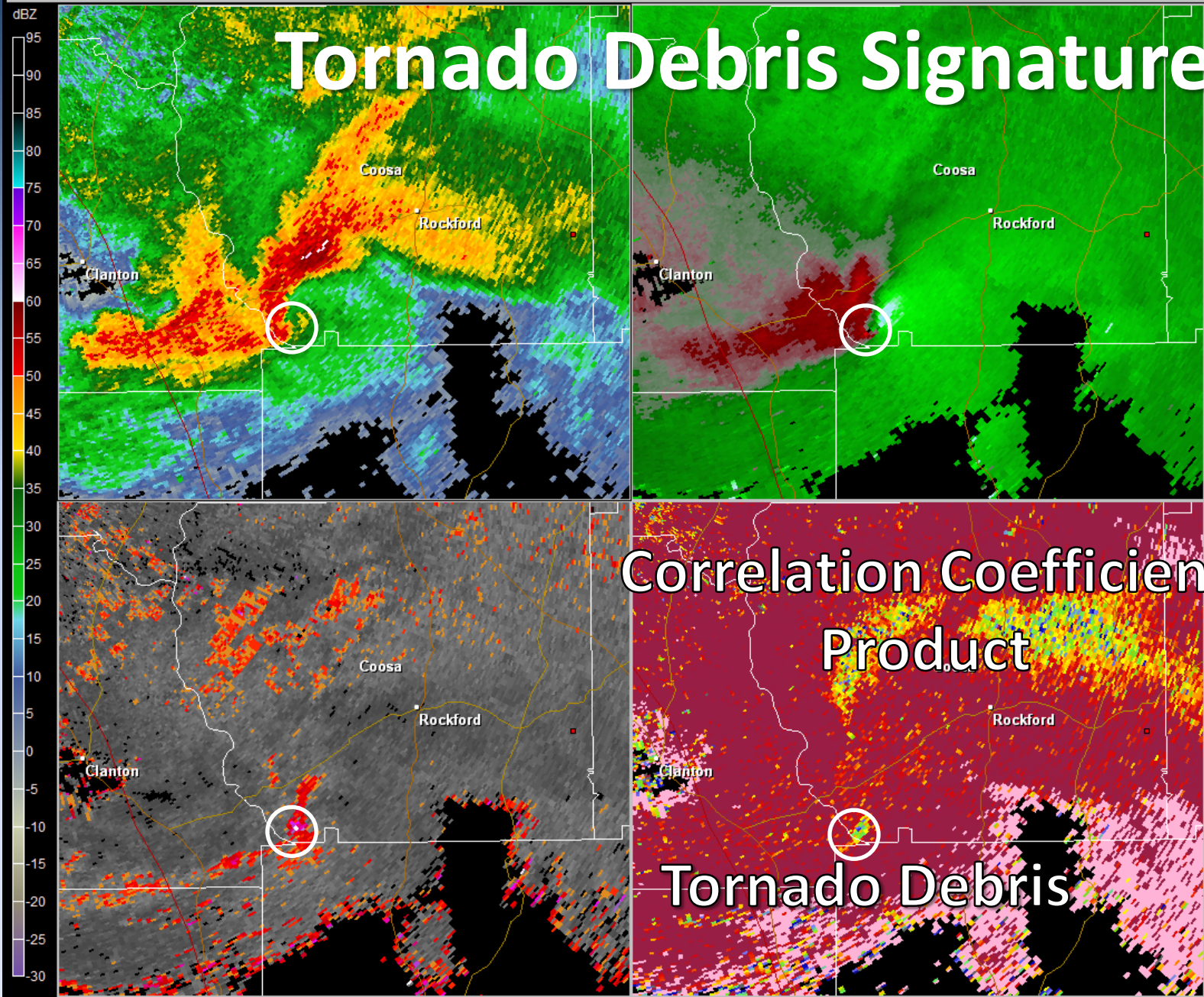
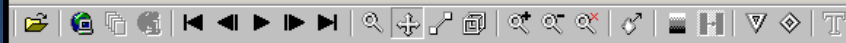


# Correlation Coefficient Product



# Tornado Debris





Site: KBMX  
VST: 03/03/2012 04:12:58 Z  
Prod: 03/03/2012 04:12:55 Z  
VCP: 212 SMV: 252° 47 kts  
Tilt: 0.532°

Select Product:

<input checked="" type="radio"/> BR	<input type="radio"/> VIL	<input type="radio"/> ZDR
<input type="radio"/> BV	<input type="radio"/> VIL	<input type="radio"/> RHO
<input type="radio"/> SRV	<input type="radio"/> POSH	<input type="radio"/> PHI
<input type="radio"/> SW	<input type="radio"/> MEHS	<input type="radio"/> KDP
<input type="radio"/> ET	<input type="radio"/> NROI	<input type="radio"/> HCA

Select Tilt:

0.5°	0.9°	1.4°	1.8°
2.4°	3.2°	4.0°	5.1°
6.4°	8.0°	10.1°	12.5°
15.7°	19.5°		

Warnings:

<input checked="" type="checkbox"/> Marine - 0
<input type="checkbox"/> Flash Flood - 0
<input checked="" type="checkbox"/> Thunderstorm - 0
<input checked="" type="checkbox"/> Tornado - 0

Product Details:

Max:	63.5 dbz
Az:	277.8°
Ran:	54.0 nm



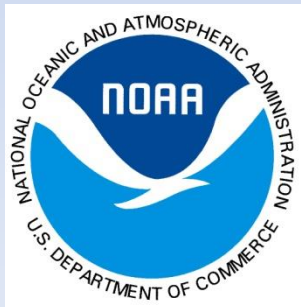
# Questions or Comments?

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[www.weather.gov/bmx/?n=graduatespottertraining](http://www.weather.gov/bmx/?n=graduatespottertraining)

Please, send me an email with the number of people in attendance at your computer, if more than one



U.S. Department of Commerce  
National Oceanic and Atmospheric Administration  
National Weather Service – Birmingham, AL

